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IN THE

Supreme Court of the United States

THE ESAB GROUP, INC.,
Petitioner,

v.

CENTRICUT LLC (NEW HAMPSHIRE) and
CENTRICUT LLC (DELAWARE)
Respondents.

Petition for Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

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PETITION FOR A WRIT OF CERTIORARI

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QUESTIONS PRESENTED

1. Whether the new standard adopted by the Federal Circuit for resolution of the issues in this appeal, and for selective application in future appeals, usurps the proper role of the trier of fact.

2. Whether the Federal Circuit's decision to credit selected portions of the testimony of a single expert witness working outside the relevant field of endeavor, to the exclusion of evidence from witnesses knowledgeable in the relevant field, undermines the established principle that patent claims are construed as they would be understood by persons of skill in the relevant art.

PARTIES TO THE PROCEEDINGS AND RULE 29.6 STATEMENT

The Petitioner in this case is The Esab Group, Inc. ("Esab"). Esab is wholly owned by Charter PLC of the United Kingdom. No other publicly held company owns ten percent or more of Esab's stock.

Respondents are Centricut LLC (New Hampshire) and Centricut LLC (Delaware). Centricut LLC (Delaware) is a wholly owned subsidiary of Hypertherm, Inc.

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PETITION FOR A WRIT OF CERTIORARI

Petitioner, The Esab Group, Inc. ("Esab"), respectfully petitions this Court for a writ of certiorari to review the judgment of the United States Court of Appeals for the Federal Circuit in this case.

OPINIONS BELOW

The opinion of the Federal Circuit in this appeal is reported at 390 F.3d 1361 and is reproduced at Page 1a of the appendix to this Petition ("App."). The opinion of the district court finding in favor of Esab on the issue of infringement is informally reported at 2003 U.S.DIST.LEXIS 12595 (D.N.H. 2003) and is reproduced at App. 17a.

JURISDICTION

The judgment of the Federal Circuit was entered on December 6, 2004. On February 4, 2005, the Federal Circuit denied a timely filed Petition for Rehearing or Rehearing *en Banc*. App. 44a. This Court has jurisdiction pursuant to 28 U.S.C. §1254(1).

STATUTORY PROVISIONS INVOLVED

Any pertinent statutes are set forth in the appendix to this brief.

INTRODUCTION

In reversing the decision of the district court in Esab's favor, the Federal Circuit panel established a new rule, for selective application in cases deemed "complex" by the Federal Circuit, whereby only testimony from a witness formally designated as an "expert" may be considered in determining the issue of patent infringement. As a result of the Federal Circuit's application of this new standard in the present appeal, the panel disregarded material admissions and additional evidence directly probative to the issue of infringement, based on controlling decisions of this Court. The approach adopted by the Federal Circuit had the direct effect of improperly usurping the role of the trier of fact.

The standard adopted by the Federal Circuit also severely undermines important, fundamental principles of patent law in that the testimony disregarded by the Federal Circuit was that of numerous witnesses (including material adverse witnesses) actively working and knowledgeable in the relevant field of endeavor. This evidence demonstrated an art-recognized distinction between the relevant properties of the materials in dispute, but was disregarded in favor of selected portions of the disputed testimony of a single witness working outside the relevant field.

Since it is axiomatic that the scope of a patent claim is determined by reference to the understanding of persons of ordinary skill in the relevant art, the new approach adopted by the Federal Circuit has the unintended effect of discarding the most directly probative evidence on the disputed issue of infringement. This issue is of vital importance to owners of existing patent rights whose legitimate expectations for the enforcement of those rights may be defeated by the new standard adopted by the panel in the present appeal.

STATEMENT OF THE CASE

A. The '425 Patent-in-Suit

This case involves the alleged infringement of U.S. Patent No. 5,023,425 ("the '425 patent"). A. 100-113.[1] The '425 patent-in-suit is directed to the field of plasma arc cutting, and specifically to an electrode for use in a plasma cutting torch. A. 1702-03 (cutaway views). Esab is a recognized leader in the field of plasma cutting. Esab's primary competitor in this field, Hypertherm, Inc., is the parent company of respondent Centricut LLC (Delaware) ("Centricut"). A. 498 (13-20); A. 869 (20) – 870 (6).

As reflected in the panel's decision in this appeal, the electrode is designed so that the electric arc emits from the so-called "emissive insert." The insert is typically formed from highly "emissive" metals such as hafnium, zirconium or tungsten. App. 3a. The emissive insert is mounted in the front end of a so-called "holder," which is typically formed of materials having relatively high thermal conductivity, in order to facilitate the transfer of heat away from the face of the electrode. *Id.* The temperatures generated by the resulting plasma gas flowing through the arc are approximately 30,000º Kelvin. App. 3a.

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[1] Citations to "A. ____" refer to the Appendix filed in the Federal Circuit appeal.

The '425 patent is directed to the problem of extending the useful life of the electrode when used in particularly harsh cutting environments employing oxidizing gases (i.e. when using air or oxygen as the plasma cutting gas). During the course of extensive development work aimed at attempting to extend the useful life of the electrode (A. 161 (13)-162 (20)), the inventor, Stan Severance, repeatedly observed the electrode failure mechanism as residing in the migration of the electric cutting arc from the face of the hafnium insert from which it was designed to emit to the adjacent copper surface of the holder, resulting in immediate failure. A. 162 (23)-163 (9).

As a result of his work, Severance theorized that the life of the electrode might be extended materially by surrounding the emissive insert material with a protective "sleeve" fashioned from a specified list of metals (preferably silver) having a relatively higher "work function" than the emissive insert, in order to resist migration of the arc from the surface of the emissive insert to the adjacent surface of the holder material. A. 164 (11-19).

The evidence received at trial was undisputed that the invention of the '425 patent was highly successful in materially extending the useful life of the electrode (with attendant benefits in increased efficiency and related economies) and that it had a substantial impact on Esab's cutting machine business relative to its competitors. A. 493 (18)-494 (7).

Centricut ultimately introduced its own version of the patented Esab electrode, incorporating the same solid silver sleeve or separator between the hafnium emissive material and the copper holder, and with the same result of substantially extended useful life. App. 6a; A. 634 (8)-635 (7); A. 176 (16)-177 (12) (more than four times the relative useful life).

The particular patent claims at issue at trial were independent claims 1 and 8. Claim 1, as reproduced at pages 3-4 of the panel's decision in the appeal (App. 4a-5a) recites, among other elements, an "insert assembly" that is comprised of an emissive insert formed of a metallic material "having a relatively low work function" and a sleeve formed from a metal selected from a specified list, and of a specified minimum thickness, that surrounds the emissive insert. The claim also provides that the metal from which the sleeve is formed has a "work function" that is greater than that of the emissive insert in order to resist movement of the cutting arc. Claim 8 is similar to Claim 1, but recites that the work function of the sleeve is greater than that of the materials comprising both the emissive insert and the holder, respectively. App. 5a (n. 1).

B. Evidence on the Issue of Infringement

The evidence received at trial established that, in both the preferred embodiment of the '425 patent and in the accused product manufactured by Centricut, hafnium was used as the metal for the emissive insert and silver was used as the metal for the protective sleeve surrounding the hafnium emissive insert (and with this combined insert assembly received in the copper holder material). App. 6a.

The evidence received at trial also included excerpts from reference texts containing comparable, measured or recommended values for the work function of silver relative to hafnium under the same conditions. These references demonstrated that the work function of hafnium was lower than the work function of silver under comparable conditions. J.A. 1357 (silver (Ag) 4.5 vs. hafnium (Hf) 3.65); J.A. 1556, "Handbook of Thermionic Properties" at J.A. 1560 and 61 (recommended value for silver 4.3 vs. 3.53 for hafnium); App. 8a (n. 3) (citing J.A. 1361-62 where fifteen of sixteen measured work function values for silver were higher than the measured work function of hafnium).

The evidence received at trial also included the testimony of numerous witnesses in the relevant field of plasma cutting, including numerous adverse witnesses, acknowledging the recognized properties of hafnium in the field of plasma cutting as a low work function, highly emissive material. For example, Centricut's expert witness in the field of plasma arc cutting testified that it had been known for many years in the field to use a low work function, highly emissive material as the emissive insert. A. 242 (18-23); A. 285 (10-17).

Centricut's former director of engineering also testified that, in the Centricut electrodes specifically, the materials were selected so that electrons were "freer to move into the arc" from the emissive insert material as compared to the holder materials surrounding the emissive insert. A. 311 (5-17) and A. 310 (5-15); *see also* A. 972 (13)-974 (14) and particularly at 974 (13-14) ("That hafnium had a low work function was understood at Centricut.").

The testimony received at trial also included the relevant testimony of Richard Couch, the former president and co-founder of Hypertherm, Esab's leading competitor in the relevant field (and owner of Centricut-Delaware, the successor in interest in this case).[2] Couch testified to an art-recognized distinction between the properties of highly emissive (i.e. low work function) materials such as hafnium, in contrast to materials having high thermal conductivity (such as silver).

Couch referred to this result as the "law of perversity" in that materials possessing desirable properties in one respect (i.e. high emissivity as in the case of hafnium) did not possess suitable properties with respect to the other (i.e. thermal conductivity as in the case of silver) and vice versa. A. 909 (19)-910 (13) and at A. 909 (25)-910 (3) in particular; *see*

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[2] Centricut's engineering director testified that people in the industry referred to Couch as the "Wizard of Plasma." A. 434 (11-12).

also A. 910 (14)-911 (12) and particularly at 910 (14-24) (ranking materials actually in dispute).[3]

Centricut's proffered expert on the issue of work function, denBoer, though concededly not a person of skill in the art of plasma cutting (A. 679 (25)-680 (4)), acknowledged the direct relationship between the emissivity of electrons and work function. A. 680 (17-22). In addition, denBoer also acknowledged that the propensity of a surface to emit electrons was a material factor in determining where the electric arc in a plasma torch would "site itself." A. 691 (19) – 692 (3).

C. Proceedings in the District Court

The present action was initiated by Centricut for a declaratory judgment of patent invalidity and non-infringement on January 27, 1999. Following a decision on Centricut's Motion for Summary Judgment on February 7, 2002 in which the district court construed the relevant claims, the case was tried before the Honorable Steven J. McAuliffe, C.J., beginning on October 21, 2002.

During the course of the trial, Centricut conceded that its accused electrode products corresponded to each of the elements of the asserted claims as previously construed by the district court, with the possible exception of the so-called "work function limitation." A. 271 (4) – 272 (6). In light of Centricut's stipulation, the remainder of the trial focused on

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[3] At A. 910 (5-13):

> THE WITNESS [Couch]: It would be nice to have a high thermal conductivity material plus high emissivity characteristics, but they don't appear . . . .
>
> THE COURT: That generally doesn't happen?
>
> THE WITNESS: That generally—we have not discovered such a material.
>
> THE COURT: In general, in this field of plasma arc cutting.
>
> THE WITNESS: Cutting.

Centricut's contentions that its accused electrodes did not necessarily meet the so-called "work function limitation" of Claims 1 and 8, and its additional contention that the '425 patent was invalid for lack of novelty and for alleged obviousness under 35 U.S.C. § 103(a).

In its decision the district court rejected Centricut's contention of patent invalidity and held that the invention of the patent-in-suit would not have been obvious to a person of ordinary skill in the art at the time the invention was made. App. 24a – 30a.

The district court also found that Esab had satisfied its burden of proof by a preponderance of evidence on the issue of infringement of the limitations of Claim 1 (silver vs. hafnium), but declined to find infringement of Claim 8 which additionally recited a higher work function relationship between the protective sleeve and the holder material (i.e. silver vs. copper).[4]

Accordingly, the district court entered judgment in favor of Esab on the issue of infringement and awarded damages of approximately $2.2 million dollars based on Centricut's sales of the accused electrode products. App. 41a.

D. The Federal Circuit's Decision

Following briefing by the parties and related oral argument, the Federal Circuit issued its decision on December 6, 2004 in which it reversed the district court's finding of infringement. In its summary of the relevant background, the panel's decision expressly acknowledged the operative defini-

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[4] In note 4, the district court observed that, at the appropriate level of understanding "i.e. the perspective of one skilled in the pertinent art," and under the prevailing standard of proof of infringement by a preponderance of the evidence, the work function tables provided an adequate basis for decision in the case, particularly in the absence of any contradictory evidence on the point. App. 22a.

tion of "work function," as adopted by the district court, based on the agreement of the parties:

> By agreement of the parties, the district court construed the term 'work function' as 'the potential step, measured in electron volts, which permits thermionic emission from the surface of a metal at a given temperature.' [citation deleted] 'Work function is an energy. It's the energy that's required to remove an electron from inside the material to outside the material.' (J.A. at 645)

App. 6a.

After presenting the operative definition of "work function," the panel additionally observed: "By definition, it is easier to move an electron from a low work-function surface than a high work-function surface." App. 6a. Thus, the panel's decision expressly acknowledges that "work function" is the measure of the ability of a metal to emit electrons (i.e. "emissivity").

Much of the balance of the panel's decision relies on selected portions of the testimony of Centricut's proffered expert on the issue of work function, Martin denBoer. While professing knowledge of the property of work function in metals, denBoer denied any relevant expertise in the field of plasma arc cutting. J.A. 679 (25) – 680 (8). Despite his lack of expertise in the plasma cutting field, however, denBoer recognized the desirability of utilizing a relatively low work function material as an emissive insert in an electrode based on his understanding of its required function, including the role of the emissive insert in establishing and maintaining the electric arc. J.A. 685 (14) – 687 (4); *see* A. 686 (5-10) in particular.[5] denBoer also equated the positioning of the cutting

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[5] ". . . because the work function is . . . the amount of energy that's required to remove an electron from a point inside the material to a point outside the material, and the lower that energy is the more likely it is that electrons will in fact emerge from a particular surface of a material . . .".

arc with the relatively higher emission of electrons (i.e. lower work function). A. 691 (19) – 692 (3).

In its decision, the panel credited other portions of denBoer's testimony in which he criticized the use of data from published tables of work function values on the basis that work function was a property of "specific surfaces, not of specific elements as represented in the tables." The panel also considered it significant that the data obtained from tables of actual work function values were measured under conditions different from those encountered in an operating plasma arc torch. App. 11a. The panel's decision does not discuss the relative feasibility of conducting such a test under the prevailing operating conditions of 30,000°K., which denBoer characterized as "not easy." A. 676 (9-18).

The panel also discounted the significance of the evidence concerning the greatly extended life of the electrodes as providing an indirect measure of the relative work function of the metal surfaces under actual operating conditions (i.e. since the arc remained attached to the emissive insert rather than attaching to the silver sleeve). Here too, the panel relied on excerpts of denBoer's testimony in which he suggested that the relatively longer useful life might be attributable to other factors. On the other hand, denBoer actually characterized his own attempts at explaining the greatly enhanced results as "speculation." App. 12a; A. 744 (2-6) ("Well, I've speculated a little bit, I'm not an expert on that.").[6]

As for the testimony of experienced witnesses in the field of plasma cutting acknowledging the distinct properties of hafnium relative to silver in terms of emissivity, this evidence

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[6] While the panel's decision relies on denBoer's suggestion that there might be other explanations for the greatly extended useful life of the electrode besides work function (App. 13a), the panel's decision does not mention that denBoer also conceded that the results also could be due to the relative work function properties of the metals in fact. A. 722 (10-25).

was dismissed by the panel in its entirety on the basis that these witnesses were not experts in "work function" specifically, and that there was "no expert testimony that emissivity and work function are the same." App. 13a. This section of the panel's decision makes no mention of the definition of work function stipulated between the parties nor does it refer to the relative significance of the qualifications of the witnesses to the resolution of the factual issues in dispute.[7]

Thereafter, while acknowledging the existence of its own precedents to the contrary, the panel went on to establish a new rule that the patentee cannot establish infringement in a case "involving complex technology" on the basis of testimony of those who are not "expert in the field."

REASONS SUPPORTING THE GRANT OF THE PRESENT WRIT

I. THE DECISIONAL FRAMEWORK ADOPTED BY THE FEDERAL CIRCUIT IMPERMISSIBLY INVADES THE PROVINCE OF THE TRIAL COURT

A. Standards Governing the Proper Scope of Review of the District Court's Decision

It is well settled under controlling precedents of this Court that original findings of fact by the district court may not be set aside unless clearly erroneous, and that "due regard" must be given to the opportunity of the trial court to judge the credibility of witnesses. Rule 52(a), Fed.R.Civ.P.; *Anderson v. City of Bessemer City, N.C.*, 470 U.S. 564, 573, (1985). Under this Court's decision in *Anderson*, a reviewing court is not permitted to reverse the findings of the trier of fact

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[7] The panel also did not acknowledge denBoer's admission that it was "customary" to express the relative emissivity of metals in terms of work function. A. 681 (8-14); *see also* 680 (17-22).

"simply because it is convinced that it would have decided the case differently." *Id.*

The rationale underlying the requirement of due deference to a district court's original findings is grounded not only in the district court's superior ability to observe the demeanor of witnesses firsthand, but additionally in fundamental fairness to the parties who have already been "forced to concentrate their energies and resources on persuading the trial judge that their account of the facts is the correct one" and that "requiring them to persuade three more judges at the appellate level is requiring too much." *Anderson v. City of Bessemer City, N.C.*, 470 U.S. at 575; *see also Icicle Seafoods, Inc. v. Worthington*, 475 U.S. 709, 714 (1986).

The significant deference due the trial court also extends to the role of controlling the admissibility and weight attributable to expert testimony. The significant "leeway" granted the trial court, in this additional respect, is reflected in this Court's precedents acknowledging the district court's essential role as the "gatekeeper" in determining whether evidence of a scientific or technical nature is sufficiently reliable or trustworthy to be attributed meaningful weight. *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137, 152-53 (1999); *see also Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 592-93, (1993).

Consistent with this Court's pronouncements in *Anderson v. City of Bessemer City*, the Federal Circuit has itself consistently held that clear error cannot be demonstrated merely by reference to the contrary views of an expert witness as presented at trial. *See Rolls-Royce Ltd. v. GTE Valeron Corp.*, 800 F.2d 1101, 1106 (Fed. Cir. 1986); *Polaroid Corp. v. Eastman Kodak Co.*, 789 F.2d 1556, 1573 (Fed. Cir.), *cert. denied*, 489 U.S. 850 (1986). As the Federal Circuit observed in its opinion in *Rolls-Royce Ltd.*, if an appellant could establish clear error by merely citing a contrary view advocated at

trial by the appellant's expert, "the fact finding role of the district court would be rendered meaningless." *Id.*

In a similar vein, numerous decisions of the Federal Circuit have also followed the related mandate of this Court that trial courts have "and must continue to have" the right to reject the testimony of any witness, including the testimony of witnesses designated as "experts." *Anderson v. City of Bessemer City*, 470 U.S. at 574-75; *Polaroid Corp. v. Eastman Kodak Co.*, 789 F.2d at 1573; *Philips Corp. v. Windmere Corp.*, 861 F.2d 695, 704 (Fed. Cir. 1988) (testimony of expert may be rejected even if unopposed), *cert. denied*, 490 U.S. 1068 (1989); *see also FMC Corp. v. Manitowoc Co., Inc.*, 835 F.2d 1411, 1416 (Fed. Cir. 1987).

B. The Panel's Decision Usurped the Role of the Trial Court

Contrary to the mandate of this Court in *Anderson v. City of Bessemer City* (and the Federal Circuit's own prior precedents), the panel in this case attributed controlling weight to selected portions of the testimony of a single witness on the disputed issue, Centricut's alleged expert on work function, denBoer.

The panel dismissed all other probative factual testimony ostensibly on the basis that much of the testimony was couched in terms of the relative "emissivity" of the disputed materials, hafnium and silver, rather than expressly in terms of work function. For this purpose, the panel relied on one excerpt of denBoer's testimony in which he indicated that "work function and emissivity are not the same." App. 13a.

Nowhere is the panel's improper foray into original fact finding (and its efforts to discount any contrary evidence) more evident than in its discussion of the relationship of emissivity to work function. For example, while the panel's decision expressly refers to denBoer's testimony that emissivity and work function are not the same, the decision does

not acknowledge denBoer's later concession (on cross-examination) that the relative emissivity of metals is customarily expressed in terms of work function specifically. A. 681 (8-14); *see also* 680 (17-22).

Similarly, the panel's decision makes no mention of the testimony of Centricut's expert witness in the actual relevant field of endeavor (plasma cutting), O'Hara, who testified that the property of "emissivity" was alternatively referred to as "work function" in the industry. A. 241 (9-22).

Notably, the panel's stated basis for dismissing the evidence couched in terms of emissivity is also contradicted by additional portions of its own opinion. In particular, in the background portion of the decision, the panel acknowledged the definition of work function adopted by the district court based on the stipulation of the parties. Work function was defined as:

> '[T]he potential step, measured in electron volts, *which permits thermionic emission from the surface of a metal at a given temperature*.' [citation omitted] 'Work function is an energy. It's the energy that's required to remove an electron from inside the material to outside the material.' (J.A. at 645).

App. 6a (emphasis supplied). The panel then observed: "By definition it is easier to move an electron from a low-work function surface than a high work-function surface" (i.e. low work function materials are more highly emissive by definition). *Id.*

Thus, the panel's own decision expressly recognizes the direct relationship between work function and emissivity. Accordingly, the testimony of knowledgeable witnesses concerning the recognized properties of hafnium in comparison to conductive metals such as silver, in the plasma cutting field, could not be disregarded merely on the basis that it was expressed in terms of "emissivity" as erroneously indicated

by the panel. *See also* A. 1081-88, in prior art U.S. Patent 3,198,932 at A. 1083 (Col. 3, lns. 23-33) ("A material is a good emitter if its work function is low.").

The Federal Circuit has consistently held that infringement may be established through circumstantial evidence and that direct proof is not required. Indeed, prior decisions have indicated that circumstantial evidence may be "more certain, satisfying and persuasive than direct evidence." *Moleculon Research Corp. v. CBS, Inc.*, 793 F.2d 1261, 1270 and 1272 (Fed. Cir. 1986) ("We have never *required* a party to proffer expert testimony . . ."), *cert. denied*, 479 U.S. 1030 (1987); *see also San Huan New Materials High Tech, Inc. v. I.T.C.*, 161 F.3d. 1347, 1360 (Fed. Cir. 1998), *cert. denied*, 528 U.S. 959 (1999).

As noted, the district court found that Esab had satisfied its burden of proof by a preponderance of the evidence by reference to published work function values that consistently ranked silver as having a higher work function than hafnium. The panel dismissed the relevance of this additional evidence, also on the basis of a selected excerpt of denBoer's testimony, in which he indicated that the reported measurements were generally obtained under conditions that were different from those prevailing in an operating plasma cutting torch. App. 11a.

There was no dispute that the measured work function values presented in various reference tables were accurate and resulted from comparable measurements or assigned valves. This was conceded in an earlier affidavit submitted by denBoer. A. 1292, ¶3 ("Such values are accepted for purposes of comparison, for example, in checking calculations of work functions, under certain specific experimental conditions, normally involving clean metals at room temperature under ultra-high vacuum.").

While denBoer criticized these measurements as not necessarily indicative of the actual work function values under torch operating conditions, he also did not propose any practical method for obtaining a direct measure of these values for hafnium and silver under the operating conditions of 30,000°K., nor did he offer any opinion that hafnium had a higher work function under prevailing torch operating conditions in fact.

In this connection, Esab attempted to demonstrate the relatively lower work function of hafnium under actual torch operating conditions circumstantially (consistent with actual measured values) by pointing to the undisputed evidence of greatly extended electrode life, based on the recognized tendency of the arc to attach to the lower work function/more highly emissive surface. This approach was corroborated by Centricut's expert witness in the field of plasma cutting who testified, based on actual experience, that electrodes prematurely failed in substantial numbers where the work function of the emissive insert was "too high." J.A. 263 (6) – 264 (17). The approach was also supported by denBoer's own testimony equating the emission of electrons with the positioning of the arc. A. 691 (19) – 692 (3).[8]

Of course, the function of weighing evidence of this type and resolving disputed factual issues is assigned to the trial court in the first instance. As a result of the new framework adopted by the panel in the present appeal (favoring selected portions of expert testimony it chose to credit to the exclusion of all other evidence), the essential role of the trier of fact was entirely usurped under the circumstances of this case.

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[8] There was also undisputed testimony that even if the hafnium insert material is positioned well off center in the holder material, the electric arc still emits off of the hafnium surface as a further indication of its lower work function under operating conditions. A. 223 (17-25).

Unless the new approach adopted by the panel in the present appeal is set aside, virtually any decision by a district court may be reversed whenever the Court of Appeals elects to unilaterally designate a case as "complex" and credit selected portions of the testimony of a witness designated as an "expert," to the disservice of the district court's proper role in weighing all of the evidence of record and reaching a fully informed decision as required by established precedents of this Court. There is no valid basis for the "special" rule adopted by the panel in the present appeal, for selective application, while its adoption threatens the fundamental and essential balance between the role of the trier of fact and that of an appellate court reviewing the district court's decision.

If it was unclear to the panel why the district court did not credit selected portions of denBoer's testimony over other portions, then the appropriate course was to remand the decision for clarification. The panel should not have adopted its new framework, however, under which it is permitted to engage in original fact finding (and then on a selective weighing of the evidence), contrary to the district court's original decision. *Icicle Seafoods v. Worthington*, 475 U.S. at 714; *Amadeo v. Zant*, 486 U.S. 214, 228 (1988).[9]

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[9] The suggestion in the panel's decision that the new framework was based on a prior decision of the Federal Circuit is incorrect. The case relied on by the panel (App. 15a) does not support the stated proposition that "typically" expert testimony will be necessary in cases involving complex technology. In the referenced section of the opinion, the Federal Circuit actually stated that testimony "typically" would be from "one skilled in the art." The passage does not refer to expert testimony and actually supports petitioner's view as discussed further in Point II. *See Schumer v. Lab. Computer Sys., Inc.*, 308 F.2d 1304, 1315 (Fed. Cir. 2002).

II. THE STANDARD ESTABLISHED BY THE FEDERAL CIRCUIT PANEL MATERIALLY UNDERMINES THE ESTABLISHED FRAMEWORK FOR CONSTRUING THE SCOPE OF ISSUED PATENTS

A. Patents are Construed by Reference to the Knowledge and Understanding of Persons of Ordinary Skill in the Art

As discussed in the immediately preceding section, the panel's decision entirely disregarded the testimony of knowledgeable, experienced witnesses (including adverse witnesses in particular) actively engaged in the field of plasma cutting. This testimony was disregarded, in material part, on the basis that the relevant witnesses were not "expert in the field."

Of course this portion of the panel's decision only begs the question of precisely what field of expertise is relevant to the disposition of the issues presented to the trial court. Apparently the panel viewed "work function" *per se* as the relevant field, rather than the field of plasma cutting.

It is well settled under controlling decisions that the claims of an issued patent are construed as they would be understood by persons of ordinary skill in the relevant art. *See United Carbon Co. v. Binney & Smith Co.*, 317 U.S. 228, 233 (1942) ("The clearest exposition of the significance which the terms employed in the claims had for those skilled in the art was given by the testimony of Weigand, one of the inventors . . ."); *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 986 (Fed. Cir. 1995), *aff'd.*, 517 U.S. 370 (1996).[10]

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[10] "Thus, the focus in construing disputed terms in claim language is not the subjective intent of the parties. . . . Rather the focus is the objective test of what one of ordinary skill in the art at the time of the invention would have understood the terms to mean."

In addition, the claims of a patent need only be as precise as the relevant subject matter permits (also as understood by persons of skill in the relevant field of endeavor). 35 U.S.C. § 112 (¶ 2); *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1575 (Fed. Cir. 1986); *Shatterproof Glass Corp. v. Libbey-Owens Ford Co.*, 758 F.2d 613, 624 (Fed. Cir.), *cert. dism.*, 474 U.S. 976 (1985); *see also Howmedica Osteonics Corp. v. Tranquil Prospects Ltd.*, 401 F.3d 1367 (Fed. Cir. 2005).

Similarly, this Court has expressly designated the testimony of persons of skill in the art as evidence relevant to the determination of infringement issues, and particularly in the context of infringement under the doctrine of equivalents. *Graver Tank & Mfg. Co., Inc. v. Linde Air Products Co.*, 339 U.S. 605, 609 (1950).[11]

B. The Evidence at Trial Demonstrated an Art-Recognized Distinction Between the Properties of the Metals in Dispute

It was undisputed that the various adverse witnesses who testified during trial, such as the President of Hypertherm, Couch, were knowledgeable and experienced in the relevant field of plasma cutting. Couch, it will be recalled, admitted that it was understood in the plasma cutting field that highly conductive materials, such as silver, were classified entirely differently from highly emissive materials, such as hafnium, in terms of their relevant properties. These properties notably include the relative emissivity of these metals in particular (i.e. work function). A. 909 (19) – 910 (24).[12]

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[11] ". . . Proof can be made in any form: through testimony of experts *or others versed in the technology*; by documents, including texts and treatises; and, of course, by the disclosures of the prior art. Like any other issue of fact, final determination requires a balancing of credibility, persuasiveness, and weight of evidence." (emphasis supplied).

[12] This case was pending (and experts designated) prior to the amendment of Federal Rule of Evidence 701 to potentially limit the scope of

In a similar vein, numerous witnesses testified to the recognition that hafnium was highly emissive in comparison to other metals and was selected for use in emissive inserts for this specific reason. A. 242 (18-23); A. 311 (5-17) and A. 310 (5-15); *see also* A. 974 (13-14) ("That hafnium had a low work function was understood at Centricut.").

The district court's opinion recognized the significance of the perspective of a person of ordinary skill in the art to the resolution of the disputed infringement issue. App. 22a (n. 4). The Federal Circuit panel, on the other hand, elevated the testimony of a non-expert in the relevant field to outcome determinative status (and then by resort only to selected portions of that testimony), while disregarding the testimony of all of the witnesses experienced in the actual relevant field of endeavor.

By elevating the testimony of a person working outside the relevant field (even a so-called expert in the unrelated field) over that of the individuals actually working in the specific technology of interest, the decisional framework established by the panel in this case presents a very real threat to the ability to enforce valuable patent rights in a meaningful fashion.

At this point, it is only necessary to proffer an expert in a "sub-specialty" concerning a parameter recited in a patent claim to testify that the property may not be as well understood as previously thought, contrary to the established under-

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opinion testimony of lay witnesses based on "scientific, technical or other specialized knowledge." The testimony of witnesses such as Couch, based on direct knowledge and experience in the relevant field, was permissible, however, under the operative version of Rule 701 applicable to this case or, alternatively, as admissions of fact by a party opponent. *See Asplundh Mfg. Div. v. Benton Harbor Engineering*, 57 F.3d 1190, 1198 (3rd Cir. 1995); *Burlington Northern Rail Co. v. State of Nebraska*, 802 F.2d 994, 1004 (8th Cir. 1986); *see also Farner v. Paccar, Inc.*, 562 F.2d 518, 529 (8th Cir. 1977).

standing of persons actually working in the relevant field. The "expert" does not even have to testify that the recited property is not present in the accused product as a fact. Under the formula adopted by the panel for the resolution of disputed infringement issues, this testimony would be outcome determinative, even though the patent claims were prepared originally on the basis of prevailing conventional wisdom in the actual relevant field.

This Court has expressed concern over changes in relevant practices that disrupt "the settled expectations of the inventing community" and that may have an adverse impact on existing patent rights. *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 28 (1997); *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., LTD.*, 535 U.S. 722, 739 (2002).

As also acknowledged recently by this Court in the context of patent infringement under the doctrine of equivalents, the nature of language "makes it impossible to capture the essence of a thing in a patent application." The particular difficulty arises from the basic fact that "things are not made for the sake of words, but words for things." *Festo v. Shoketsu Kinzoku*, 535 U.S. at 731 (citing *Autogiro Co. of America v. United States*, 181 Ct. Cl. 55 (1967)).

These basic principles are equally applicable to the resolution of infringement issues generally. Unless the new framework adopted by the panel in the present appeal is set aside, and the significance of the testimony of persons of actual skill in the relevant field restored to its proper place in the infringement analysis, the legitimate rights and expectations of owners of valuable patent rights will be defeated as a practical matter.

Since the particular language selected to define the invention in the first instance is based on the perspective of a person of ordinary skill in the relevant art, then too must any

valid test for infringement take into account that same understanding in applying the claims to third party conduct. Accordingly, and consistent with prior precedents of this Court, the framework adopted by the Federal Circuit panel in the present appeal must be set aside in favor of an approach which permits the trial court to take all relevant evidence into account, including the testimony of those knowledgeable in the relevant field of endeavor.

CONCLUSION

For the foregoing reasons, the petition should be granted and the judgment below reversed.

Respectfully submitted,

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APPENDICES

APPENDIX A

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

03-1574, -1614

CENTRICUT, LLC (New Hampshire),
Plaintiff/Counterclaim Defendant-Appellant,

and

CENTRICUT, LLC (Delaware),
Counterclaim Defendant-Appellant,

v.

THE ESAB GROUP, INC.,
Defendant/Counterclaimant-Cross Appellant.

Edward A. Haffer, Sheehan Phinney Bass & Green, PA, of Manchester, New Hampshire, argued for plaintiffs/counterclaim defendants-appellants. With him on the brief were *Michael J. Bujold* and *Neal E. Friedman*, Davis & Bujold, P.L.L.C., of Manchester, New Hampshire.

Blas P. Arroyo, Alston & Bird, LLP, of Charlotte, North Carolina, argued for defendant/counterclaimant-cross appellant. With him on the brief was *Richard M. McDermott*.

Appealed from: U.S. District Court for the District of New Hampshire

Judge Steven J. McAuliffe

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

03-1574, -1614

CENTRICUT, LLC (New Hampshire),
Plaintiff/Counterclaim Defendant-Appellant,

and

CENTRICUT, LLC (Delaware),
Counterclaim Defendant-Appellant,

v.

THE ESAB GROUP, INC.,
Defendant/Counterclaimant-Cross Appellant.

DECIDED: December 6, 2004

Before MICHEL, CLEVENGER, and DYK, *Circuit Judges.*

DYK, *Circuit Judge.*

Centricut, LLC (New Hampshire) and Centricut, LLC (Delaware) (collectively "Centricut") appeal the judgment of the United States District Court for the District of New Hampshire, finding that Centricut infringed U.S. Patent No. 5,023,425 (the "'425 patent") and assessing damages in favor of The Esab Group, Inc. ("Esab"), the assignee of the '425 patent. Esab cross appeals the damages award. We hold that Esab did not meet its burden in proving infringement, reverse the judgment of infringement, and dismiss the cross appeal as moot.

BACKGROUND

The central issue in this case is whether the absence of relevant expert testimony resulted in a failure of proof.

3a

I

Esab and Centricut are competitors in the plasma arc cutting torch market. Both companies manufacture and sell electrodes used in plasma arc torches. The electrodes must be replaced periodically. Centricut manufactures replacement electrodes. Esab is the assignee of the '425 patent, which claims an electrode for plasma arc torches and a method of fabricating the electrode. Centricut filed for a declaratory judgment that its product did not infringe the '425 patent. Centricut also sought a declaration that the '425 patent was invalid and unenforceable. Esab counterclaimed, alleging that Centricut had infringed, *inter alia*, claims 1 and 8 of the '425 patent.

II

Plasma arc torches use an electric arc to superheat a stream of gas to temperatures of around 30,000 degrees Kelvin. This heated, ionized gas, or plasma, is used to cut metal. Different gasses are used to cut metals of different types and thicknesses. Oxygen gas is particularly suitable for cutting carbon steel up to one and one-half inches thick. However, cutting with oxygen is difficult because its use leads to frequent electrode failures and short electrode life.

Most prior art plasma arc torch electrodes consist of two parts: an emissive insert and a holder. The electric arc (that heats the gas) knits off of the emissive insert and runs between the electrode and the metal being cut. The emissive insert is commonly made of a metal such as hafnium, zirconium, or tungsten, or an alloy of these metals. The emissive insert is embedded in the holder. The holder is commonly made of a high thermal conductivity metal such as copper or an alloy of copper, and apparently cools the emissive insert with means such as circulating water.

The electrode of the '425 patent renders the plasma arc cutting of carbon steel by use of oxygen gas more economical

as compared to prior art electrodes. The '425 patent discloses a three-part electrode that comprises an emissive insert, a holder, and a sleeve positioned between the emissive insert and the holder. The emissive insert and holder of the '425 patent's electrode are composed of the same materials as prior art electrodes. '425 patent, col. 3, II. 4-46. The '425 patent states that prior art electrodes operating in an oxidizing environment, such as oxygen or air, fail when the copper holder oxidizes and begins to support the arc in preference to the emissive insert. *Id.* at col. 1, II. 33-43. This occurs because oxidized copper has a lower "work function" than non-oxidized copper. *Id.*

What is different about the '425 patent is the sleeve. The sleeve is made of a material, such as silver, with a high "work function" relative to the emissive insert. *Id.* at cols. 1-2. The addition of the sleeve keeps the arc on the emissive insert even as the copper holder becomes oxidized and thus increases the electrode's useful life. *Id.* at col. 2, II. 23-28. Therefore, according to the '425 patent, the improved performance of the electrode is a result of the relative "work functions" of the emissive insert, the holder, and the sleeve.

Claim 1 of the '425 patent is stated in terms of "work function" and reads:

> 1. An electrode adapted for supporting an arc in a plasma arc torch and comprising
>
> a metallic holder having a front end, and a cavity in said front end, and
>
> an insert assembly mounted in said cavity and *comprising an emissive insert composed of a metallic material having a relatively low work function, and a sleeve surrounding said emissive insert* so as to separate said emissive insert from contact with said holder, *said sleeve* having a radial thickness of at least 0.1 inches at said front-end and being composed of a metallic material *having a work function which is greater than that of the*

material of said emissive insert, and said sleeve being composed of a metal which is selected from the group consisting of silver, gold, platinum, rhodium, iridium, palladium, nickel, and alloys wherein at least 50% of the composition of the alloy consists of one or more of said metals and

whereby said sleeve acts to resist movement of the arc attachment point from said insert to said holder.

Id. at col. 7, II. 26-47 (emphases added).[1]

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[1] Claim 8 provides:

8. An electrode adapted for supporting an arc in a plasma arc torch and comprising

a metallic tubular holder defining a longitudinal axis and having a front end and a rear end, and a transverse end wall closing said front end, said transverse end wall having a substantially planar outer front face which is perpendicular to said longitudinal axis, and a cavity formed in said front face and which extends rearwardly along said longitudinal axis, and

an insert assembly mounted in said cavity and comprising

(a) a generally cylindrical emissive insert disposed coaxially along said longitudinal axis and having an outer end face lying in the plane of said front face of said holder, said emissive insert being composed of a metallic material having a relatively low work function so as to be adapted to readily emit electrons upon an electric potential being applied thereto, and

(b) *a sleeve* positioned in said cavity coaxially about said emissive insert, said sleeve having a radial thickness of at least about 0.1 inches at said front end and *being composed of a metallic material having a work function which is greater than that of the material of said holder and greater than that of the material of said emissive insert*, said metallic sleeve being selected from the group consisting of silver, gold, platinum, rhodium, iridium, palladium, nickel, and alloys wherein at least 50% of the composition of the alloy consists of one or more of said metals, and

whereby said sleeve acts to resist movement of the arc attachment point from said insert to said holder.

'425 patent, col. 8, II. 27-61 (emphases added).

By agreement of the parties, the district court construed the term "'work function' as 'the potential step, measured in electron volts, which permits thermionic emission from the surface of a metal at a given temperature.'" *Centricut, LLC v. Esab Group, Inc.*, No. 99-CV-39, slip op. at 9 (D.N.H. Feb. 7, 2002). "Work function is an energy. It's the energy that's required to remove an electron from inside the material to outside the material." (J.A. at 645.) By definition it is easier to move an electron from a low work-function surface than a high work-function surface.

Centricut's accused electrode is similar to Esab's patented electrode. It comprises an emissive insert composed of hafnium or hafnium alloy, a holder composed of copper or copper alloy, and a ring or washer (which Esab viewed as satisfying the "sleeve" requirement) composed of silver or silver alloy positioned between the emissive insert and the holder.[2] Like Esab's electrode, the Centricut electrode exhibits significantly reduced electrode failure and a longer useful life than prior art electrodes when used with oxygen gas.

III

The district court held a bench trial to determine (1) whether Centricut's accused device infringed claims 1 and 8 of the '425 patent; (2) whether the '425 patent was invalid due to

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[2] The '425 patent includes several limitations, in addition to work function, that Centricut argues its accused device does not meet. First, Centricut contends that the "sleeve" limitation is not met because the accused device has a ring or washer surrounding only the front portion of the emissive insert, while the sleeve of the patent surrounds substantially all of the emissive insert. Second, Centricut contends that the "cavity" limitation is not met because the hole into which the emissive insert and sleeve of the accused device are mounted is a through-hole (i.e., it does not have a back end) while the patent calls for a blind cavity. The district court held in favor of Esab on both of these claim construction issues. On appeal, Centricut urges that the district court's construction of these claim limitations was also erroneous. In view of our disposition, we do not reach these issues, and accordingly do not discuss them further.

anticipation or obviousness; and (3) what, if any, damages should be awarded if the '425 patent was in fact valid and infringed. There was no dispute concerning the district court's claim construction of the work-function limitation. The question was whether the accused device satisfied the limitation. Both parties called witnesses to testify on infringement and with respect to work function, although Centricut was the only party to introduce expert testimony. Neither party introduced any evidence of tests conducted to directly measure the work function of the materials used in the accused device. Indeed, neither party introduced evidence of tests or other evidence concerning the exact materials used in the accused device. The only test evidence that Esab introduced concerning the accused device concerned the useful life. In that test, Esab used prior art electrodes and the accused device for long periods of time, usually until the point of failure. The tests showed that the accused device had an average useful life over four times longer than prior art electrodes.

Centricut's expert, physics professor Dr. Marten denBoer, testified that it was not possible to determine the relative work functions of the sleeve and the emissive insert of the accused device without direct testing because many factors affect the work function of a surface. In support of this testimony he submitted tables from various reference texts reporting the work functions of samples of various pure elements, but concluded that these tables established nothing about the relative work function of the sleeve and emissive insert of the accused device. This is because work function is not an intrinsic property of a metal, but is rather a property of specific surfaces under specific conditions. The tables were therefore not representative of the torch under actual operating conditions.

In contrast, Esab argued that the tables showed the Centricut electrode infringed because the work-function values recorded in the tables for hafnium were lower than almost all of those recorded for silver. Esab argued alternatively that the

useful life testing was a surrogate for relative work function and that, because Centricut's accused electrode displayed a significantly longer useful life than prior art electrodes, it must be because the sleeve had a higher work function than the emissive insert. Finally, Esab argued that the relative work functions of hafnium and silver could be inferred from hafnium's use in emissive inserts and silver's nonuse in emissive inserts. As discussed in greater detail below, Esab introduced no expert testimony in support of any of these three alternative theories.

Claims 1 and 8 of the '425 patent differ in that claim 1 requires the sleeve to have a work function higher than that of the emissive insert, whereas claim 8 requires the sleeve to have a work function higher than that of both the emissive insert and the holder. The district court concluded that Centricut had infringed claim 1, and indicated that the work-function limitation of claim 1 had been satisfied.

The district court noted Esab's argument that the long useful life of the accused electrode must be due to the relative work functions of the sleeve and emissive insert. *Centricut, LLC v. Esab Group, Inc.*, No. 99-CV-39, slip op. at 6 (D.N.H. July 9, 2003). However, although the district court mentioned the useful life theory, it did not adopt it. Instead, the district court held that the work-function limitation of claim 1 was met by the accused device by relying upon the tables[3] originally submitted by Centricut's expert, stating:

> Centricut established that physical circumstances could be manipulated in such a way that some silver could

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[3] The work-function tables reported work-function values for numerous elements. Many of the tables before the court provided data on multiple samples of the same element using multiple methods for measuring work function. For example, one table reports sixteen work-function values for silver ranging from 3.08-4.81 eV. (J.A. at 1361.) The same table reported a single value of 3.53eV for hafnium. (*Id.* at 1362.) On this table, one of the work-function values reported for silver was less than the work-function value reported for hafnium.

> indeed have a work function lower than that of some halfnium [sic]. At the same time, however, it is clear from the scientific references excerpted in Esab's Exhibit 25 [the tables] that silver commonly has a higher work function than halfnium [sic]. Nothing in the record suggests that Centricut made its silver sleeves from one of the relatively few low-work-function forms of silver. It is more likely than not that the accused electrodes' sleeves were made from common forms of silver having a higher work function than halfnium [sic].

Id. at 8 (footnote omitted). Thus, the district court found that Centricut's insert was made of hafnium and its sleeve was made of silver, and, because the tables commonly disclosed higher work-function values for silver than hafnium, Centricut's electrode probably infringed. The district court defended its use of the work-function tables by concluding that although the tables "might not establish to a physical certainty that the silver used by Centricut has a higher work function than the halfnium [sic] in its inserts, those standard references are sufficiently persuasive to support that finding by a preponderance of the evidence." *Id.* at 8 n.4.

In contrast, the district court held that Centricut did not infringe claim 8 because "the readily available work-function tables disclose too great an overlap in relative work-function values for silver and copper to give rise to a reliable inference one way or the other." *Id.* at 10. The district court refused to find infringement under the doctrine of equivalents, holding that "Esab's admittedly imprecise description of the physics of plasma arc torch operation is fatal to its claim of infringement under the doctrine of equivalents." *Id.* at 11. The district court further held that claim 1 of the '425 patent was not invalid due to anticipation or obviousness. Based upon its finding of infringement of claim 1 of the '425 patent, the district court ordered Centricut to pay $2,182,972.24 in damages plus prejudgment interest, and enjoined Centricut from

infringing claim 1 of the '425 patent. Centricut appeals.[4] Esab cross appeals the damages award. We have jurisdiction pursuant to 28 U.S.C. § 1295(a)(1).

DISCUSSION

This case presents the question whether Esab satisfied the burden of proof on infringement in the absence of expert testimony comparing the claims as construed with the accused device. We hold that Esab failed to carry its burden.

I

The district court's determination of infringement is a question of fact that we review for clear error. *Apex Inc. v. Raritan Computer, Inc.*, 325 F.3d 1364, 1371 (Fed. Cir. 2003). "A finding is 'clearly erroneous' when although there is evidence to support it, the reviewing court on the entire evidence is left with the definite and firm conviction that a mistake has been committed." *United States v. United States Gypsum Co.*, 333 U.S. 364, 395 (1948).

II

The patentee has the burden of proving infringement by a preponderance of the evidence. *Seal-Flex, Inc. v. Athletic Track and Ct. Constr.*, 172 F.3d 836, 842 (Fed. Cir. 1999). Centricut argues that Esab did not satisfy its burden of proof on infringement because it did not show that the accused device satisfied the work-function limitation. Esab argues that it did, for three reasons. None of these theories was supported by expert testimony.

First, Esab urges (a little half-heartedly) that the district court's reasoning was correct. As noted above, the district court found the work-function tables showed that the accused device met the work-function limitation by a preponderance

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[4] The district court's holding that the '425 patent was not invalid has not been appealed.

of the evidence, even though the only expert testimony directly contradicted this conclusion.

Centricut called as its witness Dr. Marten denBoer, a physics professor who was qualified as an expert witness on the issue of work function. He filed an expert report to which a number of work-function tables from various scientific reference books were appended. The tables reported the measured work functions of samples of various pure metals, including silver and hafnium. In the report, Dr. denBoer attempted to rank the work functions of copper, hafnium, and silver. He concluded that "tabulated values of . . . work function are . . . of limited value in attempting to rank work functions of specific materials" because many factors affect the work function of a surface. (J.A. at 1335.) Dr. denBoer's subsequent testimony and affidavits supported his conclusion in the report that reference to work-function tables is an unreliable way to rank the work functions of specific materials. In particular, he testified that work function is a property of specific surfaces, not of specific elements as represented in the tables. He also testified that the tables were prepared under much different conditions than a torch in operation and that these differences in conditions greatly impact the work function measurement. He concluded that the tables were not probative as to the relative work functions in the actual accused device.

Esab barely mentions the work-function tables in its brief. Esab points to no expert testimony or contrary testimony supporting the use of the tables.

III

Alternatively Esab urges that it satisfied its burden of proof on the work-function issue by showing that the accused device had a longer useful life than devices without the sleeve and that the extended useful life was attributable to work function. Esab's sole testimony attempting to show that use-

ful life is a surrogate for work function was the testimony of the inventor, Wayne Severance. His testimony can be read to support Esab's theory. Severance provided an explanation for why useful life is probative of work function. He testified that the failure of an electrode usually occurs when the arc moves off of the hafnium insert and onto the copper holder. When this occurs, the holder rapidly deteriorates and the electrode is destroyed. He theorized that the arc moves because the copper holder oxidizes to the point where its work function is lower than that of the hafnium insert. He further theorized that the silver sleeve resists the movement of the arc from the insert to the holder because the sleeve has a higher work function, and, therefore, the arc is less likely to knit off of the sleeve. When asked about other properties that might explain the longer useful life, Severance testified that work function was the only explanation.

However, Centricut presented extensive expert testimony by Dr. denBoer that longer useful life could be attributed to a number of different factors, including temperature, the geometry of the electrode, the thermal and electrical conductivity of the sleeve, or the sleeve's resistance to oxidation, and that it was not reasonable to conclude that longer useful life was attributable to work function. Dr. denBoer, Centricut's work-function expert, stated unequivocally that, while he did not know why the sleeve affects useful life, the useful life tests conducted by Esab told him "absolutely nothing about work function." (J.A. at 679.)

As with the first theory, there was no supporting expert testimony. Severance, the inventor, was not qualified as an expert witness on any matter under Rule 702 of the Federal Rules of Evidence. More to the point, he admitted that he was not an expert on the issue of work function. He admitted that he had not studied the subject at college, and had no graduate degree. He also did not claim to have acquired an expert's knowledge of work function during the course of his employ-

ment. In short, he offered no foundation for offering reliable testimony on work function.

IV

Esab offers a final theory as to why the accused device reads on claim 1 of the '425 patent. Esab asserts that testimony regarding the general properties of hafnium and silver, and their use within the plasma arc torch field, was sufficient to prove that the work-function limitation was satisfied. Esab argues that it is generally known that hafnium is highly emissive and that its use in emissive inserts proves this, while silver is a poor emitter, and that its nonuse in emissive inserts proves this. Esab theorizes that emissivity and work function are the same.

Again the district court made no finding supporting such a theory, and again the theory was not supported by expert testimony. There was no expert testimony that emissivity and work function are the same. The only expert witness to address the issue, Dr. denBoer, testified that although they are related, work function and emissivity are not the same. None of the witnesses upon which Esab relies for the contrary view had an expert knowledge of work function. Charles Landry identified himself as Centricut's director of engineering and technical support, but affirmatively disclaimed expert knowledge of work function. Daniel O'Hara was Centricut's plasma arc cutting torch expert, but he too admitted to having "a limited understanding of work function." (J.A. at 278.) Richard Couch, CEO of Centricut's parent company Hypertherm, testified that, although he was skilled in the art of plasma arc torches, he was familiar with work function only "in a very general sort of way." (J.A. at 908.) Patrick Byrne, the former president, CEO, and chairman of the board of Centricut, testified that someone explained work function to him during his first day at Centricut, but that he never discussed work function again in the three years he was there,

nor did he have any sort of scientific training. Severance, a senior staff engineer at Esab and the inventor of the '425 patent, cannot be considered an expert on work function for the reasons already discussed. In summary, all of the witnesses upon which Esab relies to support this argument lacked expert knowledge of work function.

Thus, each of Esab's three theories suffers from the same deficiency: none is supported by expert testimony. The first theory, adopted by the district court, rests on the district court's own interpretation of the evidence. The latter two theories rest on the testimony of witnesses who were admittedly not experts on work function.

V

In many patent cases expert testimony will not be necessary because the technology will be "easily understandable without the need for expert explanatory testimony." *Union Carbide Corp. v. Am. Can Co.*, 724 F.2d 1567, 1573 (Fed. Cir. 1984); *see also Bernhardt, L.L.C. v. Collezione Europa USA, Inc.*, 386 F.2d 1371, 1384 (Fed. Cir. 2004). But there is no claim that this is such a case. Indeed, in this case the technology involved was complex. The district court concluded that "the field of technology from which [the invention] sprang is so poorly understood that it qualifies as a `black art.'" *Centricut, LLC v. Esab Group, Inc.*, No. 99-CV-39, slip op. at 20 n.6 (D.N.H. July 9, 2003).

In other areas of the law courts have held that relevant expert testimony regarding matters beyond the comprehension of laypersons is sometimes essential.[5] Expert testimony

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[5] *See, e.g., Wills v. Amerada Hess Corp.*, 379 F.3d 32, 36-37, 41 (2d Cir. 2004) (estate of a deceased seaman suing under the Jones Act claimed that long-term exposure to toxic chemicals caused the decedent's death; held "that: . . . expert testimony on the issue of causation is necessary in Jones Act cases where a lay juror could not be expected to intuit the causal relationship between the acts in question and the injury"); *Allison*

may be similarly important in patent cases involving complex technology such as this one. Where the field or art is complex, we have repeatedly approved the use of expert testimony to establish infringement. *See, e.g., Ultradent Prods., Inc. v. Life-Like Cosmetics, Inc.*, 127 F.3d 1065, 1070 (Fed. Cir. 1997). We have also noted that "typically" expert testimony will be necessary in cases involving complex technology. *Schumer v. Lab. Computer Sys., Inc.*, 308 F.3d 1304, 1315 (Fed. Cir. 2002).

We do not state a per se rule that expert testimony is required to prove infringement when the art is complex. Suffice it to say that in a case involving complex technology, where the accused infringer offers expert testimony negating infringement, the patentee cannot satisfy its burden of proof by relying only on testimony from those who are admittedly not expert in the field. That is what happened here, and the patentee thus failed to satisfy its burden of proof. This case stands as an apt example of what may befall a patent law plaintiff who presents complex subject matter without inputs from experts qualified on the relevant points in issue when the accused infringer has negated infringement with its own expert.

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v. McGhan Med. Corp., 184 F.3d 1300, 1320 (11th Cir. 1999), ("expert testimony was essential to prove causation" in products liability case); *Mitchell v. United States*, 141 F.3d 8, 13 (1st Cir. 1998) ("Under Massachusetts tort law . . . a plaintiff in a medical malpractice action may carry his or her burden of proof on the issues of negligence and causation only with the assistance of expert testimony.") (citations omitted); *Whelan Assocs. Inc. v. Jaslow Dental Labs., Inc.*, 797 F.2d 1222, 1232-33 (3d Cir. 1986) ("expert testimony is essential to even the most fundamental understanding of " computer programs that were the subject of the copyright infringement case); *Carroll v. Beto*, 421 F.2d 1065, 1068 (5th Cir. 1970) (lay testimony not sufficient to establish competence to stand trial; "expert testimony [is] essential" to the determination of accused's competence to stand trial).

Esab does not argue that a remand is necessary or appropriate to determine infringement under the doctrine of equivalents. Esab's cross appeal of the district court's damages award is dismissed as moot.

CONCLUSION

The decision of the district court is

REVERSED.

COSTS

No costs.

APPENDIX B

UNITED STATES DISTRICT COURT
DISTRICT OF NEW HAMPSHIRE

Civil No. 99-039-M
Opinion No. 2003 DNH 115

CENTRICUT, LLC,
Plaintiff

v.

ESAB GROUP, INC.,
Defendant

v.

CENTRICUT, LLC (NEW HAMPSHIRE) AND
CENTRICUT, LLC (DELAWARE),
Counterclaim Defendants

ORDER

Centricut, LLC has preemptively sued Esab Group, Inc. ("Esab"), holder of United States patent 5,023,425 ("the '425 patent"), seeking a declaratory judgment that: (1) it has not infringed the '425 patent; (2) the '425 patent is invalid on a variety of statutory grounds;[1] and (3) the '425 patent is unenforceable under the doctrine of laches and estoppel. Esab counterclaims against Centricut, LLC (New Hampshire) and Centricut, LLC (Delaware) (collectively "Centricut"), assert-

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[1] Specifically, Centricut asserts that the '425 patent should be declared invalid, void, and/or unenforceable under 35 U.S.C. § 112, ¶ 2 (for indefiniteness), under §§ 102(a) and (b), under § 103 (for obviousness), and under § 112, ¶ 1 (for failure to meet the enablement requirement and to set forth the best mode).

ing infringement of the '425 patent and infringement of United States patent Des. 384,682. By order dated February 7, 2002 (document no. 52), the court denied Centricut's motion for partial summary judgment and also ruled against Centricut on its indefiniteness defense. See 35 U.S.C. § 112, ¶ 2. The case was tried to the bench, beginning on October 21, 2002.

Infringement

Under the United States Patent Act, "[e]xcept as otherwise provided . . . whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefor, infringes the patent." 35 U.S.C. § 271(a).

> An infringement analysis requires two steps: construction of the claims, to determine their scope and meaning, and comparison of the properly construed claims to the allegedly infringing device or method. *Cybor Corp. v. FAS Techs., Inc.*, 138 F.3d 1448, 1454 (Fed. Cir. 1998) (*en banc*). Claim construction . . . is a matter of law . . . . *Lockheed Martin Corp. v. Space Sys./Loral, Inc.*, 249 F.3d 1314, 1323 (Fed. Cir. 2001). The comparison of claims to the accused device or method, and the corresponding determination of infringement, whether literal or under the doctrine of equivalents, is a question of fact. *Tanabe Seiyaku Co. v. United States Int'l Trade Comm'n*, 109 F.3d 726, 731 (Fed. Cir. 1997).

J & M Corp. v. Harley-Davidson, Inc., 269 F.3d 1360, 1366 (Fed. Cir. 2001) (parallel citations omitted).

"A claim is literally infringed when the accused device literally embodies each limitation of the claim." *Kraft Foods, Inc. v. Int'l Trading Co.*, 203 F.3d 1362, 1370 (Fed. Cir. 2000) (citing *Pall Corp. v. Micron Separations, Inc.*, 66 F.3d 1211, 1217 (Fed. Cir. 1995)). Infringement under the doctrine

of equivalents occurs when "the accused product or process maintain[s] elements identical or equivalent to each claimed element of the patented invention." *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 40 (1997). "The determination of equivalence should be applied as an objective inquiry on an element-by-element basis." *Id.*

> Equivalence is shown by evidence that the accused device contains an element that is not "substantially different" from any claim element that is literally lacking [in the accused device], *see* [*Warner-Jenkinson*, 520 U.S. at 40], or that the claimed limitation and the accused component "perform[] substantially the same function in substantially the same way to achieve substantially the same result," *see Ethicon Endo-Surgery, Inc. v. United States Surgical Corp.*, 149 F.3d 1309, 1321 (Fed. Cir. 1998).

Kraft Foods, 203 F.3d at 1371 (parallel citations omitted).

At issue here are independent Claims 1 and 8 of the '425 patent. The parties stipulated at trial that the only remaining issue is whether the accused Centricut electrodes meet the "work function" limitations of Claims 1 and 8. With respect to work function, Claim 1 discloses

> an insert assembly . . . comprising *an emissive insert composed of a metallic material having a relatively low work function*, and a sleeve surrounding said emissive insert so as to separate said emissive insert from contact with said holder, *said sleeve* having a radial thickness of at least about 0.01 inches at said front end and *being composed of a metallic material having a work function which is greater than that of the material of said emissive insert*, and said sleeve being composed of a metal which is selected from group consisting of silver, gold, platinum, rhodium, iridium, palladium, nickel, and al-

loys wherein at least 50% of the composition of the alloy consists of one or more of said metals . . .

'425 patent, col. 7, 11. 30-43 (emphasis added). Claim 8, by contrast, discloses

an insert assembly . . . comprising

(a) a generally cylindrical emissive insert . . . *said emissive insert being composed of a metallic material having a relatively low work function* so as to be adapted to readily emit electrons upon an electrical potential being applied thereto, and

(b) *a sleeve* positioned . . . about said emissive insert, said sleeve having a radial thickness of at least about 0.01 inches at said front end and *being composed of a metallic material having a work function which is greater than that of the material of said holder and greater than that of the material of said emissive insert*, said metallic sleeve being selected from the group consisting of silver, gold, platinum, rhodium, iridium, palladium, nickel, and alloys wherein at least 50% of the composition of the alloy consists of one or more of said metals . . .

'425 patent, col. 8, 11. 37-58 (emphasis added).

Given the parties' stipulations, two questions arise: (1) whether the accused electrodes have sleeves made from a metallic material having a work function greater than that of their emissive inserts (which would establish infringement of Claim 1); and (2) whether the accused electrodes have sleeves made from a metallic material having a work function greater than those of both their emissive inserts and their holders (which would establish infringement of Claim 8).[2]

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[2] While claim construction is the first step in an infringement analysis, *see J & M Corp.*, 269 F.3d at 1366, the parties do not contest the construction of the claim limitations at issue here.

I. *Claim 1*

Esab did not offer evidence of work-function testing, but instead sought to prove infringement by demonstrating that the accused electrodes have a relatively long work life, and, therefore, must necessarily have sleeves made of a metallic material having a work function greater than that of their emissive inserts. (Generally speaking, the sleeves at issue are composed of silver and silver alloys, while the emissive inserts are composed of halfnium, and the holders are composed of copper.) Rather than testing the metallic materials from which Centricut made its electrodes, Esab tested the electrodes themselves, by putting them into plasma arc torches and operating the torches until the electrodes failed.

Centricut countered that: (1) work function is a complex phenomenon, dependent upon many variables, such that a single metallic material, like silver, may have multiple work functions, based upon differences in the temperature, clean-liness, and surface characteristics (including oxidation) of a given sample; (2) due to the number of variables affecting work function, general work-function tables commonly used by engineers and metallurgists are virtually useless in determining the work function of a discrete sample of metallic material; (3) it is theoretically possible for a particular sample of silver, with the right set of physical characteristics, to have a work function lower than the work function of a particular sample of halfnium; and (4) Esab misunderstands precisely why its electrodes last longer than those previously available in the marketplace. (Centricut suggested that the arc attaches to the electrode along its centerline, regardless of the metallic material located there, due to the swirling vortex of gasses directing the arc to that particular point. A silver sleeve extends the life of an electrode, Centricut says, not because its comparatively high work function prevents the arc from drifting over to the relatively fragile copper holder, but because silver is a superior heat conductor and forms better bonds with halfnium and copper than halfnium and copper form with each other.)

Centricut established that physical circumstances could be manipulated in such a way that some silver could indeed have a work function lower than that of some halfnium.[3] At the same time, however, it is clear from the scientific references excerpted in Esab's Exhibit 25 that silver commonly has a higher work function than halfnium. Nothing in the record suggests that Centricut made its silver sleeves from one of the relatively few low-work-function forms of silver. It is more likely than not that the accused electrodes' sleeves were made from common forms of silver having a higher work function than halfnium.[4] The court finds that Centricut's electrodes do literally infringe Claim 1 of the '425 patent.

II. *Claim 8*

A. *Literal Infringement*

Given the infringement of Claim 1, Centricut has also infringed Claim 8's similar limitation regarding electrodes with sleeves that have a higher work function than their emissive inserts. However, Claim 8 includes an additional limitation: the sleeve material must *also* have a work function

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[3] Standard references report many more work function values for silver than for halfnium. One source lists a single work function for halfnium but sixteen for silver, based upon three different testing methods.

[4] Centricut is, of course, correct in asserting that one cannot look to a reference-book table to conclusively ascertain the work function of a specific sample of metallic material. But, while such evidence might not establish to a physical certainty that the silver used by Centricut has a higher work function than the halfnium in its inserts, those standard references are sufficiently persuasive to support that finding by a preponderance of the evidence. At the appropriate level of understanding, *i.e.*, the perspective of one skilled in the pertinent art, and for the purpose of proving infringement by a preponderance of the evidence, the work-function tables offered by Esab do provide an adequate basis for decision in this case, particularly in the absence of any contradictory evidence on the point. This issue is not, of course, what might be possible, but what is probable with regard to the relative work functions of the silver and halfnium used in the accused electrodes.

higher than that of the material from which the holder is made. In both electrodes, the relevant metallic materials are silver (the sleeve) and copper (the holder).

Unlike silver and halfnium, which have relatively little overlap in terms of the work-function values disclosed in commonly used reference books, the work-function values ascribed to silver and copper do substantially overlap. Many forms of copper have work functions *higher* than many forms of silver. Thus, the court cannot conclude that it is more likely than not that Centricut manufactured electrodes with silver sleeves having higher work functions than their surrounding copper holders. While Esab did explain the benefits of using a sleeve made from a material with a higher work function than the emissive insert, the record does not identify any useful benefit associated with a sleeve material having a higher work function than that of the surrounding holder. Because Esab has not proven, by a preponderance of the evidence, that the accused electrode embodies the limitation of a sleeve with a work function higher than that of its holder, Esab has not proven that Centricut literally infringed Claim 8 of the '425 patent. In short, the readily available work-function tables disclose too great an overlap in relative work-function values for silver and copper to give rise to a reliable inference one way or the other. As noted, the accused devices were not tested to determine the actual work functions of the metallic materials from which they were made.

B. *Infringement under the Doctrine of Equivalents*

In its request for findings of fact and rulings of law, Esab describes the legal standard applicable in proving infringement under the doctrine of equivalents. But, it does not develop an argument based on the doctrine of equivalents in its post-trial memorandum of law. Given the evidence of record in this case, it is not possible to engage in a meaningful equivalence analysis.

Because Esab did not prove the work function of the copper in Centricut's holders, the court cannot reliably determine whether the accused electrode embodies the limitation disclosed in the patent. Further difficulties arise from Esab's failure to establish: (1) the function to be served by the claimed difference in work function; (2) the way in which that function is performed; and (3) the specific result achieved by the work-function differential. *See Kraft Foods*, 203 F.3d at 1371 (citation omitted). In other words, Esab's admittedly imprecise description of the physics of plasma arc torch operation is fatal to its claim of infringement under the doctrine of equivalents.

To summarize, Esab has proven by a preponderance of the evidence that Centricut infringed Claim 1, but not Claim 8, of the '425 patent. Because Centricut has not infringed Claim 8, the following discussion of invalidity pertains only to Claim 1.

Invalidity

Centricut argues that even it did infringe the '425 patent, it is not liable to Esab because the '425 patent is invalid on grounds of anticipation and obviousness.

Patents are presumed valid. 35 U.S.C. § 282. Nevertheless, a party may defend against a claim of infringement by attacking the validity of the patent sued upon. *See* 35 U.S.C. § 282(2). Of course, "[t]he burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity." 35 U.S.C. § 282. "To overcome [the] presumption of validity, the party challenging a patent must prove facts supporting a determination of invalidity by clear and convincing evidence." *Schumer v. Lab. Computer Sys., Inc.*, 308 F.3d 1304, 1315 (Fed. Cir. 2002) (citing *Apotex USA, Inc. v. Merck & Co.*, 254 F.3d 1031, 1036 (Fed. Cir. 2001), *cert. denied* 534 U.S. 1172 (2002)). Finally, "[i]n analyzing validity, '[t]he first step involves the proper interpretation of the claims [while] [t]he second step involves

determining whether the limitations of the claims as properly interpreted are met by the prior art.'" *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1333 (Fed. Cir. 2002) (quoting *Beachcombers, Int'l, Inc. v. WildeWood Creative Prods., Inc.*, 31 F.3d 1154, 1160 (Fed. Cir. 1994)).[5]

I. *Lack of Novelty/Anticipation*

Centricut argues that Claim 1 of the '425 patent is invalid for lack of novelty because it was anticipated by Japanese Laid-Open Patent Application No. Sho 60-247491 ("the Kojo patent"), filed on May 24, 1984. Esab counters that the electrode claimed in the '425 patent was not anticipated by the Kojo patent, because the '425 patent claims a "sleeve having a radial thickness of at least about 0.01 inches" while the Kojo patent discloses "a boundary layer . . . formed by plating treatment such as electroplating, chemical plating, etc. or . . . welding or . . . deposition." The court agrees that Claim 1 of the '425 patent was not anticipated by the Kojo patent.

Under the Patent Act, one necessary condition of patentability is novelty. The novelty provision of the Patent Act provides, in pertinent part:

> A person shall be entitled to a patent unless—
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States . . .

35 U.S.C. § 102. "Anticipation under 35 U.S.C. § 102 means lack of novelty, and is a question of fact. To anticipate, every

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[5] As with Esab's infringement claim, Centricut's invalidity defenses involve no contested issues of claim construction.

. . . limitation of the claimed invention must be found in a single prior art reference." *Beckson Marine, Inc. v. NFM, Inc.*, 292 F.3d 718, 725 (Fed. Cir. 2002) (quoting *Brown v. 3M*, 265 F.3d 1349, 1351 (Fed. Cir. 2001)).

Here, Centricut has failed to produce clear and convincing evidence that Claim 1 of the '425 patent was anticipated by the Kojo patent. Specifically, the limitation of a "sleeve having a radial thickness of at least about 0.01 inches" is not present in the Kojo patent. The Kojo patent discloses a "boundary layer" between the emissive insert and the holder, but indicates no minimum thickness requirement. Given the precision with which sleeve thickness was claimed in the '425 patent, the absence of any indication of thickness in the Kojo patent, and the specific methods of fabrication disclosed in the Kojo patent, which include techniques such as electroplating and chemical plating, Centricut's evidence does not rise to the level of clear and convincing proof that the Kojo patent disclosed a sleeve with a radial thickness of at least about 0.01 inches.

The court is also not persuaded by Landry's testimony regarding his general inspection, at an unspecified time and place, of an electrode similar to those disclosed in the Kojo patent, or conjecture by O'Hara as to the significance of cross-hatching rather than a single line in one of the Kojo patent drawings. While such evidence may be suggestive of a boundary layer of some thickness, it does not clearly and convincingly establish that the boundary layer disclosed in the Kojo patent was, necessarily, at least about 0.01 inches thick.

Accordingly, Claim 1 of the '425 patent is not invalid on grounds of anticipation (or lack of novelty).

II. *Obviousness*

Centricut argues that even if the '425 patent is not invalid for lack of novelty, it is invalid for obviousness, in light of the

Kojo patent. Esab counters that the electrode claimed in the '425 patent is not rendered obvious by the electrode claimed in the Kojo patent because: (1) the Kojo patent teaches the use of a boundary layer made of "nickel, chrome, etc." rather than silver, while silver is disclosed in the '425 patent as "a preferred material;" (2) prior to the invention of the electrode disclosed in the '425 patent, there was a well-recognized need in the plasma arc cutting industry for longer-lasting oxygen electrodes; (3) the Esab electrode was commercially successful; (4) Centricut emulated the Esab electrode; and (5) a six-person team at Thermal Dynamics, seeking to develop longer-lasting oxygen electrodes, experimented with silver, but never developed a silver sleeve like the one disclosed in the '425 patent. The court agrees that Claim 1 of the '425 patent is not invalid for obviousness.

The non-obviousness provision of the Patent Act provides, in pertinent part:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which subject matter pertains. . . .

35 U.S.C. § 103(a).

> Obviousness is a legal conclusion based on underlying findings of fact. *In re Dembiczak*, 175 F.3d 994, 998 (Fed. Cir. 1999). The underlying factual inquiries are: "(1) the scope and content of the prior art; (2) the level of ordinary skill in the prior art; (3) the differences between the claimed invention and the prior art; and (4) objective evidence of nonobviousness." *Id.*

Beckson Marine, 292 F.3d at 725-26 (parallel citations omitted).

In turn, objective evidence of nonobviousness

> includes the commercial success of the patented invention, whether the invention addresses "long felt but unsolved needs," and the failure of others to produce alternatives to the patented invention.

In re GPAC Inc., 57 F.3d 1573, 1580 (Fed. Cir. 1995) (quoting *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966)).

As noted earlier, the Kojo patent discloses a boundary layer, but not a sleeve that is at least 0.01 inches thick. Moreover, Centricut has identified no other prior art that discloses the sleeve element claimed by the '425 patent. So, this is not a case of "obviousness . . . established by combining the teachings of the prior art." *In re GPAC*, 57 F.3d at 1581 (citation omitted).

More importantly, however, even if Centricut had established that all the elements of Claim 1 of the '425 patent had been taught by some combination of prior art references, Centricut has failed to provide any evidence to support a finding that "the combined teachings of the prior art references . . . suggest, expressly or by implication, the improvements embodied by the invention." *Id.* (citing *In re Sernaker*, 702 F.2d 989 (Fed. Cir. 1983)). In other words, Centricut has produced no evidence to show that "the prior art . . . provide[d] a suggestion or motivation" to replace the boundary layer in the Kojo patent with the sleeve claimed in the '425 patent. *Heidelberger Druckmaschinen AG v. Hantscho Commercial Prods., Inc.*, 21 F.3d 1068, 1072 (Fed. Cir. 1994) (citing *Northern Telecom, Inc. v. Datapoint Corp.*, 908 F.2d 931, 934 (Fed. Cir. 1990); *In re Geiger*, 815 F.2d 686, 688 (Fed. Cir. 1987) (obviousness cannot be established by combining pieces of prior art absent some "teaching, suggestion, or incentive supporting the combination")). Because no prior art either discloses a sleeve or suggests the benefit of anything thicker than a "boundary layer" between the emissive insert

and the holder of an oxygen electrode, Centricut has provided no evidence to demonstrate that it would have been obvious to one skilled in the art of plasma arc cutting that a silver sleeve would increase the effective life of an oxygen electrode.

In terms of the *Beckson Marine* factors, Centricut has failed to demonstrate that the prior art includes any reference to the sleeve element of the '425 patent (factor 1), which means that the claimed invention is substantially different from the prior art (factor 3). Thus, both factors weigh in favor of Esab. Factor 4, objective evidence of obviousness, also weighs in favor of Esab. The Esab electrode was a commercial success because it lasted longer than other oxygen electrodes, thus meeting a long-standing unsolved need in the plasma arc cutting torch industry. While there may be lingering questions about the precise electrochemical processes that cause the Esab electrode to last longer than electrodes without a silver sleeve,[6] it is apparent that the addition of the silver sleeve was the inventive step that gave the Esab electrode its commercial advantage. *See In re GPAC*, 57 F.3d at 1580 (citations omitted).

For the reasons given above, the addition of a silver sleeve to an electrode composed of an emissive insert set in a copper holder was an improvement in electrode design that would not have been obvious to one skilled in the art at the time of the invention claimed in the '425 patent. Accordingly, Centricut has failed to prove, by clear and convincing

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[6] Centricut makes much of the physical mysteries of plasma arc cutting, to the point of suggesting that plasma arc cutting is a "black art." If indeed plasma arc cutting is so poorly understood, and if advances in the field come exclusively through trial and error, it seems somewhat anomalous for Centricut also to argue that the invention claimed by Esab was obvious. In other words, it is difficult to see how Esab's invention could be obvious when the field of technology from which it sprang is so poorly understood that it qualifies as a "black art."

evidence, that Claim 1 of the '425 patent is invalid for obviousness.

Damages

Esab seeks both lost profits and enhanced damages for willful infringement. Centricut argues that the proper measure of damages is a reasonable royalty rate rather than lost profits, and that enhanced damages are inappropriate because any infringement was not willful.

The damages provision of the Patent Act provides, in pertinent part:

> Upon finding for the claimant the court shall award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer, together with interest and costs as fixed by the court.

35 U.S.C. § 284. In determining the proper measure of damages, the following principle applies:

> The question to be asked in determining damages is "how much had the Patent Holder and Licensee suffered by the infringement. And that question [is] primarily: had the Infringer not infringed, what would Patent Holder-Licensee have made?"

Aro Mfg. Co. v. Convertible Top Replacement Co., 377 U.S. 476, 507 (1964) (quoting *Livesay Window Co. v. Livesay Indus., Inc.*, 251 F.2d 469, 471 (5th Cir. 1958)).

The Patent Act establishes a "reasonable royalty" as the minimum level of legally adequate damages to compensate for infringement. *See King Instruments Corp. v. Perego*, 65 F.3d 941, 947 n.2 (Fed. Cir. 1995) (citing *Rite-Hite Corp. v. Kelley Co.*, 56 F.3d 1538 (Fed. Cir. 1995) (*en banc*)). In other words, "the purpose of [the reasonable royalty] alternative is not to direct the form of compensation, but to set a floor

below which damage awards may not fall." *Rite-Hite*, 56 F.3d at 1544 (citing *Del Mar Avionics, Inc. v. Quinton Instr. Co.*, 836 F.2d 1320, 1326 (Fed. Cir. 1987)). In the event that damages in the amount of a reasonable royalty are inadequate to compensate for infringement, the court may award other damages, such as lost profits.

In addition, "the court may increase the damages up to three times the amount found or assessed." 35 U.S.C. § 284. Finally, "the patent owner [Esab] bears the burden of proving by a preponderance of the evidence the quantum of damages, [which is] an issue of fact. . . ." *Transclean Corp. v. Bridgewood Servs., Inc.*, 290 F.3d 1364, 1370 (Fed. Cir. 2002) (citing *SmithCline Diagnostics, Inc. v. Helena Labs. Corp.*, 926 F.2d 1161, 1164 (Fed. Cir. 1991)).

I. *Lost Profits*

Esab argues that adequate compensation for Centricut's infringement consists of profits lost through: (1) Centricut's sale of infringing electrodes;[7] (2) erosion of the price Esab could charge for its own electrodes, due to infringing competition from Centricut;[8] and (3) Esab's lost opportunities to sell nozzles and other torch parts that are typically sold along with electrodes.[9] Centricut contends that the proper measure of damages is a reasonable royalty, and that a reasonable

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[7] The parties agree that Centricut sold 152,707 infringing electrodes between 1997 and 2002. However, while Esab asserts that it lost profits of $1,817,672 on those sales, Centricut contends that under a reasonable royalty calculation, Esab's damages amount to only $221,425.15.

[8] Esab claims losses of $903,343 resulting from price erosion.

[9] Esab claims $1,086,440 in lost profits from nozzle sales it allegedly did not make as a result of Centricut's sales of infringing electrodes, and $1,559,588 in profits lost from other torch-part sales it would have made if not for Centricut's infringement. According to Centricut, if damages are awarded for Esab's lost profits from sales of nozzles and other torch parts, those damages should also be based on a reasonable royalty, and amount to $219,826 for nozzle sales and $155,956 for sales of other torch parts.

royalty rate is ten percent of the price Centricut charged its customers for the infringing electrodes, because that is the rate Centricut pays Esab under two current licenses, one for a nitrogen electrode and one for a nitrogen nozzle. Centricut further argues that if damages are awarded for lost sales of nozzles and other torch parts, the ten-percent royalty rate should also apply.

The Patent Act directs the court to award damages adequate to compensate for infringement, without specifying any particular form of compensation. *See Rite-Hite*, 56 F.3d at 1544. Wide latitude is granted in determining damages. *See id.* at 1543-44; *State Indus., Inc. v. Mor-Flo Indus., Inc.*, 883 F.2d 1573, 1576-77 (Fed. Cir. 1989) ("Deciding how much to award as damages is not an exact science, and the methodology of assessing and computing damages is committed to the sound discretion of the district court.") (citation omitted).[10]

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[10] This point is underscored by the various ways in which courts have dealt with the availability of damages based upon the sale of unpatented items that are closely associated with patented devices. Such damages have been allowed both in reasonable-royalty cases, *see Ga.-Pac. Corp. v. U.S. Plywood Corp.*, 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970) (listing, as a factor relevant to determining a reasonable royalty, "[t]he effect of selling the patented specialty in promoting sales of other products of the licensee; the existing value of the invention to the licensor as a generator of sales of his non-patented items; and the extent of such derivative or convoyed sales"), and in lost profits cases, *see Kalman v. Berlyn Corp.*, 914 F.2d 1473, 1485 (Fed. Cir. 1990) (affirming award of damages based upon profits lost on sales of unpatented filter screens that were usually sold along with the device disclosed in the patent in suit). Similarly,

> [w]hen a patentee seeks damages on unpatented components sold with a patented apparatus, courts have applied a formulation known as the "entire market value rule" to determine whether such components should be included in the damage computation, whether for reasonable royalty purposes, *see Leesona Corp. v. United States*, 599 F.2d 958, 974 (Ct. Cl. 1979), or for lost profits purposes, *see Paper Converting Machine Co. v. Magna-Graphics Corp.*, 745 F.2d 11, 23 (Fed. Cir. 1984).

Rite-Hite, 56 F.3d at 1549 (parallel citations omitted).

Damage awards for lost profits are governed by the following rule:

> To recover lost profits damages for patent infringement, the patent owner must show that it would have received the additional profits "but for" the infringement. The patent owner bears the burden to present evidence sufficient to show a reasonable probability that it would have made the asserted profits absent infringement. *See, e.g., Del Mar Avionics, Inc. v. Quinton Instr. Co.*, 836 F.2d 1320, 1326 (Fed. Cir. 1987).

King Instruments, 65 F.3d at 952 (parallel citations omitted). Lost profits damages are particularly appropriate in the context of a two-supplier market. *See Shockley v. Arcan, Inc.*, 248 F.3d 1349, 1363 (Fed. Cir. 2001) (citing *Lam, Inc. v. Johns-Manville Corp.*, 718 F.2d 1056, 1068 (Fed. Cir. 1983)); *see also State Indus.*, 883 F.2d at 1578 ("In the two-supplier market, it is reasonable to assume, provided the patent owner has the manufacturing and marketing capabilities, that it would have made the infringer's sales.") (citation omitted). Moreover, when awarded, lost profits damages are generally subject to the following test, under which the patentee must establish:

> (1) demand for the patented product; (2) absence of acceptable non-infringing substitutes; (3) manufacturing and marketing capability to exploit the demand; and (4) the amount of the profit it would have made.

Rite-Hite, 56 F.3d at 1545 (citing *Panduit Corp. v. Stahlin Bros. Fibre Works, Inc.*, 575 F.2d 1152, 1156 (6th Cir. 1978)).

Here, Esab has failed to establish the second element of the *Panduit* test. Specifically, Centricut's Silverline electrode appears to be an "acceptable non-infringing substitute[]" for Esab's patented electrode. *Id.* While Esab offered testimony that customers seeking long-life oxygen electrodes were unlikely to purchase Centricut's Silverline electrodes, because they look different from both Esab's patented electrodes and

Centricut's infringing electrodes, the fact remains that the Silverline electrode was available in the market and could well have been purchased, instead of Esab's electrodes, had the infringing electrodes not been available for sale. In sum, Esab has failed to prove by a preponderance of the evidence that at the time of Centricut's infringement, there was an absence of acceptable non-infringing substitutes in the market. Accordingly, Esab is not entitled to lost profits damages, under the test set out in *Panduit*.

Even though Esab is not entitled to lost profits damages, it is entitled to damages adequate to compensate for Centricut's infringement. Because each of the three categories of damages claimed by Esab could, conceivably, factor into the calculation of a reasonable royalty, each category of damages is considered in turn.

A. *Centricut's Sales of Infringing Electrodes*

As noted, the parties agree upon the number of infringing electrodes Centricut sold; the only question is the amount of damages to award for each sale. Centricut argues for a ten-percent royalty (which works out to $1.45 per electrode), while Esab contends that it should be awarded the same rate of profit it earned on the electrodes it sold itself (which works out to approximately $11.90 per electrode). Neither approach is quite right.

Centricut's position—that a reasonable royalty is ten percent of the price it charged its customers for the infringing electrodes—is not well supported in the record. Esab granted Centricut licenses to manufacture and/or sell nitrogen electrodes and nozzles in exchange for a ten-percent royalty, but those license agreements are not the best measure of damage resulting from Centricut's manufacture and sale of the oxygen electrodes at issue here. The record demonstrates that Esab allows several after-market suppliers to sell its oxygen

electrodes.[11] Because those electrodes are identical to those at issue in this case, the royalty Esab negotiated with its licensees provides a more reasonable measure of Esab's damages than the royalty rate specified in the nitrogen electrode licensing agreements between Centricut and Esab.[12] Accordingly, the court rejects Centricut's argument that a ten-percent royalty is adequate to compensate Esab.

While a ten-percent royalty would undercompensate Esab, Esab's calculation of lost profits damages would lead to overcompensation. Specifically, Esab's calculation fails to account for the availability of the Silverline electrode in the market and the likelihood that at least some customers would have purchased Silverline electrodes rather than Esab electrodes in the absence of the infringing electrodes. Thus, adequate compensation for Centricut's sales of the infringing electrodes falls somewhere between the ten-percent royalty Centricut advocates and the lost profits calculation advanced by Esab.

An award of $10.50 per infringing electrode, less the cost of manufacture, will provide Esab with full and fair compen-

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[11] Esab began selling its oxygen electrodes to American Torch Tip ("ATT") under an agreement that resulted from Esab's discovery that ATT had been attempting to market an allegedly infringing electrode. Under that agreement, ATT stopped manufacturing the challenged electrode, and now buys Esab electrodes for resale, paying Esab $10.50 per electrode. In contrast, Zap Plasmatherm/Thermacut ("ZP/T"), which also resells Esab's oxygen electrodes, initially approached Esab with a request to purchase unbranded Esab electrodes for resale to its customers. ZP/T buys Esab electrodes for $12 each.

[12] In one of the leading cases on patent infringement damages, the court compiled "[a] comprehensive list of evidentiary facts relevant, in general, to the determination of the amount of a reasonable royalty for a patent license." *Georgia-Pacific*, 318 F. Supp. at 1120. The first item on that list is "[t]he royalties received by the patentee for the licensing of *the patent in suit*, proving or tending to prove an established royalty." *Id.* (emphasis added).

sation for Centricut's sales of infringing electrodes. Esab agreed, after arm's-length negotiations, to accept $10.50 for each electrode it sold to American Torch Tip which, like Centricut, is an after-market supplier of torch parts.[13] However, because Esab incurred the cost of manufacturing the electrodes it sold to ATT, but did not incur the cost of manufacturing the infringing electrodes, Esab is not entitled to a full $10.50 for each infringing electrode Centricut sold. Rather, the royalty must be reduced by Esab's manufacturing costs. Accordingly, as a result of Centricut's sales of infringing electrodes, Esab is entitled to damages in the amount of $1,096,532.24, which represents $10.50 for each of the 152,707 infringing electrodes, for a total of $1,603,423.24, less $506,891.26 in manufacturing costs.

B. *Price Erosion*

With regard to price-erosion damages, the failure to obtain lost profits damages undermines Esab's price-erosion claim. Indeed, such damages generally have been regarded as a category of lost profits. *See, e.g., Vulcan Eng'g Co. v. FATA Alum., Inc.*, 278 F.3d 1366, 1377 (Fed. Cir. 2002); *Lam*, 718 F.2d at 1065 ("Lost profits may be in the form of diverted sales, eroded prices, or increased expenses."). As a logical matter, it is difficult to see how downward price pressure on a licensor's patented invention could possibly increase a reasonable royalty, when that term is defined as "the amount that `a person, desiring to manufacture [, use, or] sell a patented

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[13] The $10.50 royalty Esab received from ATT, rather than the $12 royalty Esab received from ZP/T, is the better measure of damages because Esab gave ATT a lower royalty rate than ZP/T due to ATT's larger volume of sales. On this record, the number of infringing electrodes Centricut sold is greater than the number Esab electrodes ATT sold. Moreover, while the record does not establish how many more Silverline electrodes Centricut would have sold if it had not sold the infringing electrodes, using the lower royalty rate provides some measure of correction for the Silverline factor.

article, as a business proposition, would be willing to pay as a royalty and yet be able to make [, use, or] sell the patented article, in the market, at a reasonable profit.'" *Trans-World Mfg. Corp. v. Al Hyman & Sons, Inc.*, 750 F.2d 1552, 1568 (Fed. Cir. 1984) (quoting *Goodyear Tire & Rubber Co. v. Overman Cushion Tire Co.*, 95 F.2d 978, 984 (6th Cir. 1938); citing *Panduit*, 575 F.2d 1152).

But even assuming price-erosion damages to be available in this case, Esab has failed to prove that it is entitled to such damages. Esab's evidence of price erosion is simply too speculative; the record contains evidence of any number of factors other than Centricut's improper competition—such as national economic trends and steel tariffs—that may well have contributed to erosion of the prices Esab was able to charge for its electrodes. Absent testimony from an economics expert, the court simply cannot find, by a preponderance of the evidence, that Centricut's infringement eroded the price that Esab was able to charge for its electrodes. Accordingly, the court declines to award damages based upon price erosion.

C. *Lost Sales of Nozzles and other Torch Parts*

The evidence of lost nozzle sales is solid enough to support an award of damages, but the evidence pertaining to lost sales of other torch parts is too speculative. As noted above, in footnote 10, lost sales of unpatented components, accessories, or other items typically sold with patented devices may be considered in the calculation of either lost profits or a reasonable royalty. Thus, absence of a lost profits damage award creates no obstacle to Esab's recovery of damages based upon lost sales of unpatented torch parts.

There are two situations in which patent infringement damages may include a patent owner's lost sales of items other than the patented device. First, under the "entire market value rule," which does not apply here, patent infringement dam-

ages may be based upon the value of an entire device, containing both patented and unpatented components, when "the unpatented and patented components together were considered to be components of a single assembly or parts of a complete machine, or they together constituted a functional unit," *Rite-Hite*, 56 F.3d at 1550 (citing *Velo-Bind, Inc. v. Minn. Mining & Mfg. Co.*, 647 F.2d 965 (9th Cir. 1981)), and when "the patent-related feature is the 'basis for customer demand,'" *Rite-Hite*, 56 F.3d at 1549 (quoting *State Indus.*, 883 F.2d at 1580; citing *TWM Mfg. Co. v. Dura Corp.*, 789 F.2d 895, 900-01 (Fed. Cir. 1986)).

Second, when an unpatented device is routinely "bundled" for "convoyed sales" along with a patented device, the scope of damages may include lost sales of the unpatented devices. *See Interactive Pictures Corp. v. Infinite Pictures, Inc.*, 274 F.3d 1371, 1385 (Fed. Cir. 2001) (upholding jury award which "rel[ied] on evidence of bundling and convoyed sales in determining the proper scope of the royalty base") (citing *Deere & Co. v. Int'l Harvester Co.*, 710 F.2d 1551, 1559 (Fed. Cir. 1983)). As the court in *Interactive Pictures* noted, "[t]he 'extent of . . . derivative or convoyed sales' is one of the often-cited *Georgia-Pacific* factors relevant to determination of a reasonable royalty rate." 274 F.3d at 1385 (quoting *Georgia-Pacific*, 318 F. Supp. at 1120).

In *Trans-World Manufacturing*, 750 F.2d at 1568, the defendant infringed the plaintiff's patent on a rack used to display eyeglasses. The district court excluded, as irrelevant to the determination of a reasonable royalty, "evidence of [defendant's] profits from the sale of [unpatented] displayed eyeglasses." *Id.* The court of appeals reversed that ruling, reasoning:

> By supplying the patented racks for displaying the eyeglasses, [defendant] Hyman used "the patented [invention] in promoting sales of" the nonpatented eyeglasses. [Plaintiff] Trans-World may be able to prove

> that Hyman's infringing use of the displays played an important part in the retail sales of Hyman's eyeglasses. Furthermore, the extent of the profits from such sales could be relevant in determining the amount of a reasonable royalty. If, for example, sales were increased because of the infringing use of the displays, that fact could affect the amount of royalties a potential licensee would be willing to pay.

Id. In *Kalman*, 914 F.2d 1473, the defendant infringed the plaintiff's patent for a filtering device, and the court of appeals affirmed an award of lost profits damages, *id.* at 1484-85, including "lost profits for the sale of unpatented screens and accessories for the [patented] Autoscreen device, in addition to those lost profits attributable to the Autoscreen body itself," *id.* at 1477 (citation omitted). The court of appeals noted that "[a]t trial, [plaintiff] Dr. Kalman testified that the screens were usually sold with the Autoscreens." *Id.* at 1485. Similar reasoning was adopted by the district court in *Andrew Corp. v. Gabriel Electronics, Inc.*, 785 F. Supp. 1041 (D. Me. 1992). In that case, the court ruled that plaintiff's net profits from sales of accessory items normally sold along with the patented horn reflector antenna were an appropriate component of the plaintiff's damages for patent infringement. *Id.* at 1051 (citing *Paper Converting Mach. Co.*, 745 F.2d at 23).

Here, Esab offered unchallenged evidence that electrodes and nozzles wear out at approximately the same rate. Thus, both those parts of a plasma arc torch typically need to be replaced at about the same time. The preponderance of the evidence supports a finding that torch operators typically prefer to purchase replacement electrodes and nozzles from the same source, at the same time. Therefore, Esab has proven that purchases of electrodes and nozzles tend to be bundled together or "convoyed." In other words, Esab has proven that Centricut's sales of infringing electrodes deprived Esab of both electrode sales and nozzle sales. Thus, for Esab to obtain damages adequate to compensate for Centricut's

infringement, the damage award must include compensation for Esab's lost nozzle sales. The court is persuaded by Esab's proffered estimates, which do not claim that each Centricut electrode sale represented a nozzle sale lost to Esab, but, instead, factor in the availability of Esab electrodes from American Torch tip and Zap Plasmatherm/Thermacut. Esab is entitled to damages in the amount of $1,086,440 for lost nozzle sales.

However, Esab has not proven by a preponderance of the evidence that it would have sold retaining caps, swirl baffles, torch bodies, or other torch parts but for Centricut's infringement. By Esab's own concession, those parts wear out much more slowly than either nozzles or electrodes. Because those parts wear out at substantially different rates than do electrodes, it is far less likely that purchases of those parts are typically bundled with purchases of electrodes. Thus, damages based upon lost sales of torch parts other than nozzles are far too speculative, and the court declines to award them.

II. *Increased Damages for Willful Infringement*

Esab contends that Centricut's infringement of the '425 patent was willful, and that Centricut's willful infringement provides the basis for an award of enhanced damages. Centricut counters that the record fails to support a finding of willful infringement. The court agrees.

When exercising its statutory discretion to award enhanced damages for patent infringement, the court may consider:

> (1) deliberate copying; (2) infringer's investigation and good-faith belief of invalidity or non-infringement; (3) litigation conduct; (4) infringer's size and financial condition; (5) closeness of the case; (6) duration of the misconduct; (7) remedial action by the infringer; (8) infringer's motivation for harm; and (9) concealment.

Transclean, 290 F.3d at 1377-78 (citing *Read Corp. v. Portec, Inc.*, 970 F.2d 816, 827 (Fed. Cir. 1992). "A finding of willful infringement '*authorizes* but does not *mandate* an

award [of] increased damages.'" *Transclean*, 290 F.3d at 1378 (quoting *Modine Mfg. Co. v. Allen Group, Inc.*, 917 F.2d 538, 543 (Fed. Cir. 1990)). In turn,

> [w]illful infringement is a question of fact, *American Med. Sys. [v. Med. Eng'g Corp.]* 6 F.3d [1523,] 1530-31 [(Fed. Cir. 1993)], and must be established by clear and convincing evidence, for "the boundary between unintentional and culpable acts is not always bright." *Pall Corp. v. Micron Separations, Inc.*, 66 F.3d 1211, 1221 (Fed. Cir. 1995).

SRI Int'l, Inc. v. Advanced Tech. Labs., Inc., 127 F.3d 1462, 1465 (Fed. Cir. 1997) (parallel citations omitted).

Esab has failed to prove willful infringement by clear and convincing evidence. Centricut's "short-sleeve" design, while infringing, plainly demonstrates a good-faith effort to design around the sleeve limitation of the '425 patent. Second, Esab's own inability to provide direct evidence of the work function of Centricut's sleeve material must also count as evidence of both the difficulty Centricut faced in selecting materials from which to manufacture a non-infringing electrode and the strong possibility of failing to do so while nonetheless acting in good faith. Finally, while the legal opinions that Centricut obtained proved incorrect, Centricut suspended production of the infringing electrodes until it had legal advice in hand. That advice was apparently procured in good faith, and gave Centricut a reasonable basis for believing that it had successfully designed around the '425 patent. *See id.* at 1464-65. Because Esab has not provided clear and convincing evidence of willful infringement, and has not made a sufficient case under any of the other *Read* factors, an award of enhanced damages is not warranted.

Conclusion

For the reasons given above, Centricut is liable for infringing Claim 1 of the '425 patent, and Esab is entitled to damages in the total amount of $2,182,972.24. The Clerk of

Court shall enter judgment in accordance with this order and close the case.

The foregoing order shall constitute the findings of fact and conclusions of law required by Rule 52 of the Federal Rules of Civil Procedure. The court notes that the parties have submitted numerous requests for findings of fact and rulings of law. It is well settled, however, that the court "does not have to make findings on every proposition put to it by the parties." *Applewood Landscape & Nursery Co. v. Hollingsworth*, 884 F.2d 1502, 1503 (1st Cir. 1989) (quoting *Morgan v. Kerrigan*, 509 F.2d 580, 588 n.14 (1st Cir. 1974)). Rather, factual findings are adequate if "sufficient to indicate the factual basis for the ultimate conclusion." *Kelley v. Everglades Drainage Dist.*, 319 U.S. 415, 422 (1943) (per curium). If either party believes that additional findings of fact or rulings of law are necessary, or even would prove helpful, it may, within fifteen days of the date of this order, submit a written request for additional findings or rulings, along with a short (but fully explanatory) statement of why each requested finding or ruling is necessary or would be helpful. All requests for findings of fact or rulings of law not expressly or implicitly granted in the body of this opinion are hereby denied.

SO ORDERED.

/s/ Steven J. McAuliffe
STEVEN J. MCAULIFFE
United States District Judge

July 9, 2003

cc: Edward A. Haffer, Esq.
Michael J. Bujold, Esq.
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APPENDIX C

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

03-1574, -1614

CENTRICUT, LLC (New Hampshire),
Plaintiff/Counterclaim Defendant-Appellant,

and

CENTRICUT, LLC (Delaware),
Counterclaim Defendant-Appellant,

v.

THE ESAB GROUP, INC.,
Defendant/Counterclaimant-Cross Appellant.

ORDER

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

ORDER

A combined petition for panel rehearing and for rehearing en banc having been filed by the CROSS-APPELLANT, and a response thereto having been invited by the court and filed by the APPELLANTS, and the petition for rehearing having been referred to the panel that heard the appeal, and thereafter the petition for rehearing en banc and response having been referred to the circuit judges who are in regular active service,

UPON CONSIDERATION THEREOF, it is

ORDERED that the petition for panel rehearing be, and the same hereby is, DENIED and it is further

ORDERED that the petition for rehearing en banc be, and the same hereby is, DENIED.

The mandate of the court will issue on February 11, 2005.

FOR THE COURT,

/s/ Jan Horbaly
JAN HORBALY
Clerk

Dated: February 4, 2005

cc: Edward A. Haffer
Blas P. Arroyo

CENTRICUT V ESAB GROUP, 03-1574, -1614
(DCT – 99-CV-39)

Note: Pursuant to Fed. Cir. R. 47.6, this order is not citable as precedent. It is a public record.

APPENDIX D

PERTINENT STATUTORY PROVISIONS

35 U.S.C. § 112 provides in pertinent part:

§ 112. Specification

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

* * * *

(2)

No. 04-1470

Supreme Court, U.S.
FILED
JUL 1 - 2005
OFFICE OF THE CLERK

IN THE

Supreme Court of the United States

THE ESAB GROUP, INC.,

Petitioner,

v.

CENTRICUT LLC (NEW HAMPSHIRE)
and CENTRICUT LLC (DELAWARE),

Respondents.

ON PETITION FOR A WRIT OF CERTIORARI TO THE
UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

BRIEF IN OPPOSITION

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QUESTIONS PRESENTED

1. Whether the Federal Circuit adopted a "new standard" usurping the role of the trier of fact, or merely correctly applied the "clearly erroneous" standard of Fed. R. Civ. P. 52(a) in reversing the Trial Court's finding of infringement?

2. Whether the Federal Circuit correctly held that ESAB failed to meet its burden of proof on infringement because it failed to present relevant expert testimony?

PARTIES TO THE PROCEEDING AND RULE 29.6 STATEMENT

The Respondents in this case are Centricut LLC (New Hampshire) and Centricut LLC (Delaware). Centricut LLC (New Hampshire) is in dissolution. Centricut LLC (Delaware) is a wholly owned subsidiary of Hypertherm, Inc.

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STATEMENT OF THE CASE

Centricut, LLC (New Hampshire) sought a declaratory judgment that it did not infringe United States Patent No. 5,023,425 ("'425 patent") of ESAB Group, Inc. ("ESAB"). ESAB counterclaimed for infringement against Centricut, LLC (New Hampshire) and its successor, Centricut, LLC (Delaware) (collectively, "Centricut"). After a bench trial, the Court found infringement by Centricut, and awarded ESAB over $2 million in damages. App. 17a.[1] The Court also permanently enjoined Centricut against future infringement. A83.[2] On appeal, the Federal Circuit reversed, holding that ESAB had failed to meet its burden of proof on infringement, because it failed to present relevant expert testimony. App. 2a. ESAB's combined petition for panel rehearing and rehearing *en banc* was denied. App. 44a.

Centricut manufactured and sold oxygen electrodes for replacement use in plasma arc torches of various manufacturers, including ESAB. *See* A296-99, 349, 944-45. Plasma is a high-temperature, ionized gas used in cutting metals; it supports an electrical arc between the torch and the metal being cut. *See* '425 Patent, Col. 1, L. 9-13 (A106). Electrodes are "consumables"; i.e., they wear out with use and must be replaced periodically. A944-45.

At issue on appeal was Independent Claim 1 of the '425 Patent, in which the following is claimed:

> 1. An electrode adapted for supporting an arc in a plasma arc torch and comprising a metallic holder having a front end, and a cavity in said front end, and an insert assembly mounted in said cavity and

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1. References to "App. __" are to the appendix to ESAB's Petition for Writ of Certiorari.

2. References to "A__" are to the appendix filed with the Federal Circuit.

> comprising an emissive insert composed of a metallic material having a relatively low *work function*, and a sleeve surrounding said emissive insert so as to separate said emissive insert from contact with said holder, said sleeve having a radial thickness of at least 0.1 inches at said front end and being composed of a metallic material having a *work function* which is greater than that of the material of said emissive insert, and said sleeve being composed of a metal which is selected from the group consisting of silver, gold, platinum, rhodium, iridium, palladium, nickel, and alloys wherein at least 50% of the composition of the alloy consists of one or more of said metals and whereby said sleeve acts to resist movement of the arc attachment point from said insert to said holder.

A109 (emphasis added).

At the bench trial, the principal issue concerned the work-function limitation.[3] "Work function is an energy. It's the energy that's required to remove an electron from inside the material to outside the material."[4] App. 6a. Finding that the accused electrode contained a "sleeve" with a higher "work function" than its "emissive insert," the Trial Court ruled that Centricut's electrode literally infringed Claim 1of the '425 Patent. App. 21a-22a.

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3. Centricut had previously moved for summary judgment, arguing, among other things, that its accused electrode did not include the "cavity" or "sleeve" limitation. However, ruling to the contrary in its claim construction, the Court denied Centricut's motion. A18-30.

4. This is how the Federal Circuit correctly described the term. App. 6a.

REASONS FOR DENYING THE PETITION

I. THE FEDERAL CIRCUIT DID NOT ADOPT A "NEW STANDARD" USURPING THE ROLE OF THE TRIER OF FACT, BUT MERELY CORRECTLY APPLIED THE "CLEARLY ERRONEOUS" STANDARD OF FED. R. CIV. P. 52(a) IN REVERSING THE TRIAL COURT'S FINDING OF INFRINGEMENT.

A. Overview

This case presents no "new standard" (ESAB Petition, Questions Presented) under which the role of a trier of fact is usurped by an appeals court. Rather, it presents an orthodox and wholly correct application of the "clearly erroneous" standard of Fed. R. Civ. P. 52(a). "A petition for a writ of certiorari will be granted only for compelling reasons." Sup. Ct. R. 10. Here, there are none.

The Federal Circuit correctly held that the Trial Court committed clear error (Fed. R. Civ. P. 52(a)) in its reliance on so-called work-function tables (App. 8a-10a) — an error that ESAB does not even mention. Also unmentioned by ESAB is the fact that the Trial Court pointedly rejected the arguments ESAB now makes (*see* Argument IC, below), a rejection the Federal Circuit upheld. App. 13a-14a. In short, the Trial Court was clearly wrong in its reliance on the work-function tables, but right in its rejection of ESAB's present arguments — now being made for the fourth time.[5]

ESAB failed to meet its burden of proof that the claimed work-function element, or its substantial equivalent, was present in the accused Centricut electrode. "It is well settled that each element of a claim is material and essential, and that in order

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5. First, at trial (*see* Argument IC); second, in its brief to the Federal Circuit (at 3-31 — *n.b.* 3-8, 16-17, and 24-31); third, in its petition for rehearing *en banc* to the Federal Circuit (at 2, 5-6, and 10-15).

for a court to find infringement, the plaintiff must show the presence of every element or its substantial equivalent in the accused device." *Lemelson v. United States*, 752 F.2d 1538, 1551 (Fed. Cir. 1985). ESAB tried to prove the work-function element through witnesses who not only lacked work-function expertise but *admitted* lacking it. This obvious failure of proof was sharply rejected by *both* the Trial Court *and* the Federal Circuit.

Yet, incredibly, it is on this very issue — on which the Trial Court and Federal Circuit completely agreed — that ESAB argues the Federal Circuit "usurped" the role of the trier of fact. The argument is false.

B. Fed. R. Civ. P. 52(a)

ESAB misconceives what the Federal Circuit did. It did not sit as a Trial Court, according varying degrees of "weight" to the testimony of the different witnesses. Rather, it reviewed, as it had to, the entire evidence to determine whether the Trial Court's finding of infringement of the '425 Patent was "clearly erroneous" under Fed. R. Civ. P. 52(a). As this Court has said: "A finding is 'clearly erroneous' when although there is evidence to support it, the reviewing court on the entire evidence is left with the definite and firm conviction that a mistake has been committed." *United States v. U.S. Gypsum Co.*, 333 U.S. 364, 395 (1948).

Here, the "entire evidence" includes a conspicuous omission. No evidence whatsoever was adduced of either the *actual* work-function values or the *actual relative* work-function rankings in the accused Centricut electrode. This was ESAB's burden to prove; and its failure was total. *Lemelson*, 752 F.2d at 1551. "Indeed, neither party introduced evidence of tests or other evidence concerning the exact materials used in the accused device."[6] App. 7a.

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6. To say, as ESAB does (at 5), that the accused device used hafnium for the insert and silver for the sleeve is imprecise and (Cont'd)

The "entire evidence" includes one and only one work-function expert: Centricut's expert, Professor Marten denBoer, a tenured full professor of physics at the City University of New York and its Graduate School. A639-45, 1292-1305. No other witness was a work-function expert. Although Professor denBoer is a physicist, the meaning of work function in physics is the same as it is in engineering — a point acknowledged by the engineer-inventor of the device claimed in the '425 Patent. A186. Professor denBoer "testified that it was not possible to determine the relative work functions of the sleeve and the emissive insert of the accused device without direct testing because many factors affect the work function of a surface."[7] App. 7a. Significantly, however, no such testing was done. *Id.*

ESAB argues:

> The approach adopted by the Federal Circuit had the direct effect of *improperly usurping the role of the trier of fact.* [ESAB Petition, at 2 (emphasis added).]

> It is well settled that . . . original findings of fact by the district court may not be set aside unless clearly erroneous, and that "*due regard" must be given to the opportunity of the trial court to judge the credibility of witnesses*. . . . The rationale underlying the requirement of *due deference to a district court's original findings is grounded* . . . [in part] *in the district court's ability to observe the demeanor of witnesses firsthand*. . . . [At 11-12 (emphasis added).]

(Cont'd)

inadequate. The hafnium and silver were not pure, but alloyed. As the Federal Circuit correctly observed, the "exact materials used in the accused device" (App. 7a) were never proved. *Id.*

7. As the Federal Circuit noted, Professor denBoer also "testified that work function is a product of specific surfaces, not of specific elements as represented in the tables." App. 11a.

The panel should not have adopted its new framework . . . under which it is permitted to engage in original fact finding (and then on a selective weighing of the evidence), contrary to the district court's original decision. [At 17 (emphasis added).]

[T]he panel's decision entirely disregarded the testimony of knowledgeable, experienced witnesses (including adverse witnesses in particular) actively engaged in the field of plasma cutting. The testimony was disregarded, in material part, on the basis that the relevant witnesses were not "expert in the field." [At 18 (emphasis added).]

[T]he framework adopted by the Federal Circuit panel in the present appeal must be set aside in favor of an approach that permits the trial court to take all relevant evidence into account, including the testimony of those knowledgeable in the relevant field of endeavor. [At 22 (emphasis added).]

One might infer from ESAB's arguments that the Trial Court credited certain testimony, and that the Federal Circuit supplanted the Trial Court's assessments with its own. Nothing could be further from the truth. The arguments that ESAB makes here — based on "the testimony of knowledgeable, experienced witnesses (including adverse witnesses in particular) actively engaged in the field of plasma cutting" (at 17) — are the very same arguments that it made to the Trial Court, to the Panel, and to the Court *en banc*. *See* Argument IC, below; ESAB's brief to the Federal Circuit (at 3-31 — *n.b.* 3-8, 16-17, and 24-31); and its petition for rehearing *en banc* to the Federal Circuit (at 2, 5-6, and 10-15). *See also* A922-24. However, the

Trial Court rightly *rejected* those arguments, calling them "very unscientific" (A924), as indeed they are. The Federal Circuit agreed. App. 13a-14a, 44a. On this point, therefore, the Trial Court and the Federal Circuit are one.

C. ESAB's "Very Unscientific" Argument

In ESAB's brief to the Federal Circuit (at 3-31 — *n.b.* 3-8, 16-17, and 24-31) and its petition for rehearing to the Court *en banc* (at 2, 5-6, and 10-15), ESAB cited extensively to the testimony of non-experts on work function.[8] However, as both the Trial Court and the Federal Circuit correctly recognized, and as each of the ESAB-cited witnesses so clearly demonstrated, knowledge of plasma cutting is emphatically *not* the same thing as knowledge of work function. Hence, both the Trial Court and the Federal Circuit properly concluded that ESAB's reliance on these non-experts was improper.[9]

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8. Much of ESAB's argument was, and is, couched in terms of "emissivity." But as Professor denBoer explained, emissivity is not the same thing as work function. (A669.) "They are related, but not the same." (*Id.*) "Emissivity is, in science, the propensity of the surface to emit, in this case, electrons." (*Id.*) "[W]ork function is the energy barrier that an electron needs to surmount to be emitted from the surface. . . ." (*Id.*) Professor denBoer also explained that "thermionic emission" and "thermionic emissivity" are related to work function, but are not the same as work function. (A668-70.) Again, as the Federal Circuit correctly said, "'Work function is an energy. It's the energy that's required to remove an electron from inside the material to outside the material." App. 6a. ESAB is therefore simply wrong when it argues, "the panel's decision expressly acknowledges that 'work function' is the measure of the ability of a metal to emit electrons (i.e., 'emissivity')."

9. It was the obvious, indeed admitted, lack of expertise of these witnesses that caused both the Trial Court and the Federal Circuit to reject ESAB's arguments. It emphatically was *not* the case, as ESAB now argues, that the "panel dismissed all other probative factual testimony *ostensibly on the basis that much of the testimony was couched in terms of the relative 'emissivity' of the disputed materials, hafnium and silver, rather than expressly in terms of work function*." At 13 (emphasis added).

Consider what the Trial Court said:

THE COURT: Yeah, if you're trying to use this witness [Mr. Landry] to establish that scientific fact, I can't let do you that. He disclaims any knowledge or expertise in the area. You didn't disclose him as an expert witness in that field. If that's your point, I can't let you do that.

MR. ARROYO: But your Honor, he's a witness also on behalf of the defendant and officer of the company. It's an admission that we can use in the case as evidence that can be used against Centricut without any, I mean, presuming —

THE COURT: Your job, again, I may be oversimplifying it, but I think I warned you many times prior to trial, you've got to simplify it. Your job is to prove that their accused device uses a silver insert at a higher work function than the emitter and the surrounding copper holder. That's your job, right? Haven't we brought it down to that, and so arguing with this witness about what he may or may not have subjectively understood about a process he never studied and hasn't been disclosed as an expert on this I guess is interesting and you can build your record if you want to do that for purposes of appeal within reasonable limits, but it's not moving the ball much.

MR. ARROYO: But your Honor, it is part of our proof. As I said, thermionic emissivity and work function are reciprocals of each other.

THE COURT: So say you, so say you, and maybe you will have some evidence that will back that up that [sic]. You're not a witness and you're not giving evidence in the case. If you're saying to me that's what I want this fellow to do, I can't let you do that. He's not a disclosed expert on the reciprocal nature of the thermionic emissions and high work function, he

hasn't been disclosed on that subject matter, he's demonstrated no expertise in the area, in fact he's disclaimed expertise in the field. He's got a two-year degree from a vocational technical school and says he never studied it in any capacity, so how can I possibly let you use him to establish that fact if that's what you're trying to do? You've got to get somebody qualified to do it and you have to have disclosed him. [A444-46.]

MR. ARROYO: All right, do you understand what the nature is of the testimony we are offering at this point in terms of the relationship between emissivity and work function?

THE COURT: I understand what your theory is, and I also understand that you're trying to extract it from witnesses that don't subscribe to your theory. I understand that.

MR. ARROYO: And by extracting it, I would hope, your Honor, that by extracting it from adverse witnesses it will make the point more soundly established.

THE COURT: But you have a basic legal problem of proof of evidence, which is he is not an expert. He's not qualified as an expert, not disclosed as an expert, disclaims expertise in the field, so that he might be persuaded to say that there's a physics equivalent here, probably wouldn't be persuasive. A, you can't use him for that purpose. You didn't disclose him as an expert. B, he's not an expert, he's not qualified to give that opinion testimony. He in fact disclaims, as I understand his testimony, he disclaims any expertise in the field of work function, so if he were to stumble into saying yes, high transfer heat rate equals low or

high work function or whatever, it doesn't move the ball, it's not reliable evidence.

MR. ARROYO: Your Honor, certainly we can agree that if a witness is an adverse party, the people in responsibility admit statements that the admissions of a party may be used in a case for all purposes —

THE COURT: Not uninformed admissions on matters of expertise, not opinions, not unqualified opinions. You get somebody on the stand to say flies come from rotten meat and I have to accept that because he's admitted it? Hardly. That's junk science as you like to point out.

MR. ARROYO: When it's admitted as a basic fact throughout the case —

THE COURT: No, no, it's not a basic fact, see, that's the problem, that's the problem, it's not a basic fact. It's not a basic fact. It's a scientific fact. So it's not a basic — it's not who did what, when, where, how. It's a principle of science that has to be proven through expert witnesses usually. [A458-60.]

ESAB cites to the testimony of Mr. Couch (at 6-7, 19-20), the CEO of Hypertherm, Centricut's parent company, calling him the "wizard of plasma." At 6, n. 2. Yet as to his own inexpert understanding of the science relating to work function, he testified as follows:

I don't understand the physical chemistry of those two materials in this oxidizing atmosphere. I don't understand it. [A913 (emphasis added).]

I really — we, as a manufacturer of this type of product or any products, want to understand the underlying

physics of what is going on, and we don't. And we have research work underway to try to understand it better, but we right now don't. [A914 (emphasis added).]

Q. *Mr. Couch, how well do you understand thermionic emissivity?*

A. *I understand it very poorly.* [A906 (emphasis added).]

ESAB also cites to the testimony of Mr. O'Hara (at 6), Centricut's expert on invalidity (an issue Centricut did not appeal). Yet as to his own inexpert understanding of the science relating to work function, he testified that he had never used work function as a criterion for designing an electrode, emissive insert, holder, or any other electrode-component for an air or an oxygen environment; never studied work function in high school, college, graduate school, or any academic setting; and had only a limited understanding of work function. A276-78. Moreover, Mr. O'Hara specifically denied that he had any understanding of ESAB's asserted reciprocal relationship between work function and emissivity (A242); indeed, he testified, "I did not relate work function and emissivity." A243.

Again, ESAB made essentially the same arguments at trial and to the Federal Circuit that it makes here — referring to, among other things, emissivity and the testimony of "Messrs. Landry, O'Hara, etcetera" and Mr. Couch. *See* A922-24; *see also* ESAB's brief to the Federal Circuit (at 3-31 — *n.b.* 3-8, 16-17, and 24-31) and its petition for rehearing to the Court *en banc* (at 2, 5-6, and 10-15). But as stated above, the Trial Court correctly recognized these arguments as "very unscientific":

THE COURT: You know, *that argument troubles me because it seems very unscientific. "It must be so because it works." No. It works. Why it works, who knows.*

MR. ARROYO: Your Honor, —

THE COURT: You don't throw a hypothesis out there and then say, my hypothesis [is] proved because it works — *you haven't isolated anything.*

MR. ARROYO: Your Honor, when —

THE COURT: Of course, *who knows why it works. Why isn't it equally true that it works because you have a heat sink function? That's why it works.*

MR. ARROYO: One of the difficulties here, your Honor, and you will recall when the —

THE COURT: In other words, *your proposition is because their electrode works, necessarily the silver has a higher work function. Necessarily. Because otherwise it wouldn't work. But there's competent evidence that, no, it works because it keeps the emissive insert cooler. That's why it works. Not because of any arc migration discouragement. Not at all.* I don't know. How do I know? [A924-25 (emphasis added).]

The Court's trial insight into ESAB's lack of proof was correct, but impermanent. Where the Trial Court went wrong, however, was *not* in adopting ESAB's present arguments; it never did. Where the Trial Court went wrong — indeed, clearly wrong — was in its post-trial decision,[10] in which it professed to rely on the work-function tables to find infringement. App. 22a, n. 4.

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10. The Trial Court's decision was issued 8½ months after trial. App. 42a; A850 and 993.

D. The Work-Function Tables

The Trial Court's clearly erroneous finding of infringement purported to rest on the work-function tables:

> [I]t is clear from the scientific references . . . [i.e., the work-function tables] that *silver commonly has a higher work function than hafnium*. Nothing in the record suggests that Centricut made its silver sleeves from *one of the relatively few low-work-function forms of silver*. It is more likely than not that the accused electrodes' sleeves were made from *common forms* of silver having a higher work function than hafnium [used for the emissive insert]. [App. 22a, n. 4 (emphasis added).]

However, no evidence was evidence adduced — let alone expert evidence — that any of the work-function tables contained "typical" or "common" work-function values for silver. Thus, the Trial Court's statement that "silver commonly has a higher work function than hafnium" (*id.*) has no evidentiary support whatsoever, let alone any expert evidentiary support.

The Federal Circuit accurately summarized the evidence on the work-function tables as follows:

> [T]he district court found the work-function tables showed that the accused device met the work-function limitation by a preponderance of the evidence, even though the only expert testimony directly contradicted this conclusion.
>
> Centricut called as its witness Dr. Marten denBoer, a physics professor who was qualified as an expert witness on the issue of work function. He filed an expert report to which a number of work-function tables from various scientific reference books were appended. The tables reported the measured work functions of samples of various pure metals, including silver and hafnium.

> In the report, Dr. denBoer attempted to rank the work functions of copper, hafnium, and silver. He concluded that "tabulated values of . . . work function are . . . of limited value in attempting to rank work functions of specific materials" because many factors affect the work function of a surface. (J. A. at 1335.) Dr. denBoer's subsequent testimony and affidavits supported his conclusion in the report that reference to work-function tables is an unreliable way to rank the work functions of specific materials. In particular, he testified that work function is a property of specific surfaces, not of specific elements as represented in the tables. He also testified that the tables were prepared under much different conditions than a torch in operation and that these differences in conditions greatly impact the work function measurement. He concluded that the tables were not probative as to the relative work functions in the actual accused device. [App. 10a-11a].

At the Federal Circuit, ESAB stayed away from the work-function tables — and with good reason. Other than a short reference to them in its brief to the Federal Circuit (at 27, n. 7), ESAB did not even mention the work-function tables. As the Federal Circuit said, "Esab barely mentions the work-function tables in its brief. Esab points to no expert testimony or contrary testimony [to Professor denBoer's] supporting the use of the tables." App. 11a.

And in its petition for rehearing *en banc*, ESAB continued to stay away from the work-function tables. Its tack was essentially the same as it had been before the Panel. Not only did it fail to tell the Court *en banc* that the Trial Court had sharply rejected its central argument; it also said nothing about the actual basis for the Trial Court's finding of infringement — the work-function tables.

Thus, at the Federal Circuit, rather than stand foursquare behind the Trial Court's rationale, ESAB left it alone. That *non*-endorsement spoke, and speaks, volumes. It amounted, and amounts, to an implicit acknowledgment of the clear error of the Trial Court's rationale. On this, ESAB was right.

But in its petition to this Court, ESAB changes tack for the first time. Now, it refers to the tables (at 5, 8 n. 4, 15, and 16),[11] and makes the following argument (at 15):

> As noted, the district court found that Esab had satisfied its burden of proof by a preponderance of the evidence by reference to published work function values that *consistently ranked silver as having higher work function than hafnium*. The panel dismissed the relevance of this additional evidence, also on the basis of a selected excerpt of denBoer's testimony, in which he indicated *that the reported measurements were generally obtained under conditions that were different from those prevailing in an operating plasma cutting torch*. App. 11a.
>
> *There was no dispute that the measured work function values presented in various reference tables were accurate* and resulted from comparable measurements or assigned valves. This was conceded in an earlier affidavit submitted by denBoer. A. 1292 ¶3 ("Such values are accepted for purposes of comparison, for example, in checking calculations of work functions, under *certain specific experimental conditions, normally involving clean metals at room temperature under ultra-high vacuum*.") [Emphasis added.]

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11. At pp. 5 and 15, however, ESAB does not use the word "tables," but instead refers to them as "reference texts" and "published work function values."

ESAB's new argument on the work-function tables should fail for waiver, since it was not raised with the Federal Circuit.[12] *See, e.g., United States v. Ortiz*, 422 U.S. 891, 898 (1975) (declining to consider issue that petitioner had not raised with appeals court). And it certainly fails for at least two other reasons.

First, ESAB's statement that "published work function values . . . consistently ranked silver as having higher work function than hafnium" is like the Trial Court's statement that "silver commonly has a higher work function than hafnium." App. 22a, n.4. Again, no evidence was evidence adduced — let alone expert evidence — that any of the work-function tables contained "typical" or "common" work-function values for silver. Thus, whatever "consistency" might appear on the face of some tables is meaningless. Furthermore, there are inconsistencies, as the Federal Circuit noted:

> The work-function tables reported work-function values for numerous elements. Many of the tables before the court provided data on multiple samples of the same element using multiple methods for measuring work function. For example, one table reports sixteen work-function values for silver ranging from 3.08-4.81eV. (J.A. at 1361.) The same table reported a single range of 3.53eV for hafnium. (*Id.* at 1362.) On this table, one of the work-function values reported for silver was less than the work-function value reported for hafnium. [App. 8a, n.3.]

Most fundamentally, to quote ESAB's paraphrase (at 15) of Professor denBoer, "the reported measurements [in the work-function tables] were generally obtained under conditions that were different from those prevailing in an operating plasma

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12. Nor was it even raised with the Trial Court, to the best of Centricut's knowledge and belief, based on its review of ESAB's Proposed Findings of Fact and Conclusions of Law and its related Post-Trial Memorandum.

cutting torch." Those differences are striking. As Centricut said in its brief to the Federal Circuit (at 16-17):

> To sum up on the work-function tables: in resting its finding solely on them, the Court clearly failed to take into account the following: (1) that the tables are based on conditions normally involving metals that are pure, clean, at room temperature, and under ultra-high vacuum; (2) that, in stark contrast, the "critical time" for determining work function for purposes of the '425 Patent is during "actual operation" — (a) when in the case of the components of the accused electrode, the metals are alloyed — not pure, (b) when the metals' surfaces are oxidized — not clean, (c) when the temperature is 30,000 degrees K[elvin] — not room temperature, and (d) when the environment is an oxidizing environment — not an ultra-high vacuum; (3) that those very oxidizing conditions will cause the work function of a *silver* surface to *fall* and the work function of a *hafnium* surface to *rise*; and (4) that for these reasons, *work function is now understood to be a variable, determined by the particular atomic arrangement of the surface under examination, and not an intrinsic property of a material.* [Emphasis added.]

Second, when ESAB says, "There was no dispute that the measured work function values presented in various reference tables were accurate," it is not merely wrong, but outrageously wrong. Centricut emphatically disputed the tables' accuracy for the purpose of determining infringement. Their glaring *un*reliability for this purpose was a critical part of Centricut's case, both at trial and on appeal. *See, e.g.,* Centricut's brief to the Federal Circuit at 6-18, 20-23.

Although it is true that Professor denBoer said, "Such values are accepted for purposes of comparison, for example, in checking calculations of work functions, under *certain specific*

experimental conditions, normally involving clean metals at room temperature under ultra-high vacuum" (A. 1292 ¶3), those conditions are starkly different from the conditions under which a plasma torch operates. For the reasons summarized at the end of the preceding paragraph, they provide absolutely no reliable basis for a finding of infringement.[13]

Indeed, ESAB itself acknowledges Professor denBoer's criticisms of the work-function tables:

> While denBoer criticized these measurements as not necessarily indicative of the actual work function values under torch operating conditions, he also did not propose any practical method for obtaining a direct measure of these values for hafnium and silver under the operating conditions of 30,000°K., nor did he offer any opinion that hafnium had a higher work function under prevailing torch operating conditions in fact. [At 16.]

Part of that statement betrays ESAB's persistent misconception about the burden of proof. It was ESAB's burden, not Centricut's, to present a "method for obtaining a direct measure of these values for hafnium and silver under the operating conditions of 30,000°K," or to present some other reliable scientific evidence from which infringement could be proved. This, however, ESAB utterly failed to do.

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13. ESAB is also outrageously wrong when it says, "There is also *undisputed testimony* that even if the hafnium insert material is positioned well off center in the holder material, the electric arc still emits off of the hafnium surface as a further indication of its lower work function under operating conditions. A. 223 (17-25)." At 16 (emphasis added). That point was hotly disputed. Professor denBoer testified diametrically to the contrary, saying among other things: "[I]t's the motion of the gas that's most decisive in determining where the arc emits from, and therefore even if the center were silver and the surround were hafnium, . . . then the arc would continue to emit from the silver." A720-21. *See also* A716-22 (denBoer) and A880-84 (Couch).

II. THE FEDERAL CIRCUIT CORRECTLY HELD THAT ESAB FAILED TO MEET ITS BURDEN OF PROOF ON INFRINGEMENT BECAUSE IT FAILED TO PRESENT RELEVANT EXPERT TESTIMONY.

The work-function piece of this case might have been entirely different *if*: (1) ESAB had offered an expert on work function; *and* (2) that expert had given evidence, contrary to Professor denBoer's, that the work-function tables *are* scientifically reliable for proving infringement here, or that some other scientific basis existed to support ESAB's claim of infringement of the work-function element. *Neither* happened, however.[14]

Fed. R. Evid. 702 provides:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness *qualified as an expert* by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, *if* (1) the testimony is based on *sufficient facts or data*, (2) the testimony is the product of *reliable* principles and methods, *and* (3) the witness has applied the principles and methods *reliably* to the facts of the case. [Emphasis added.]

Note also the Advisory Committee Notes to the 2000 Amendment to Fed. R. Evid. 701: "Rule 701 has been amended to eliminate the risk that the *reliability requirements* set forth in Rule 702 will be evaded through the simple expedient of proffering an expert in lay witness clothing." (Emphasis added.)

ESAB's efforts to evade the reliability requirements of Rule 702 rightly failed. Both the Trial Court and the Federal Circuit

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14. ESAB refers (at 19, n. 12) to the designation of "experts" (plural). But the only expert it designated was a patent agent, who had no work-function expertise and did not even give evidence at trial.

were correct in rejecting ESAB's "very unscientific" arguments based on non-expert testimony. As the Federal Circuit said:

> By agreement of the parties, the district court construed the term "'work function' as 'the potential step, measured in electron volts, which permits thermionic emission from the surface of a given material.'" . . . "Work function is an energy. It's the energy that's required to move an electron from inside the material to outside the material." [App. 6a.]

> Indeed, in this case the technology involved was complex. The district court concluded that "the field of technology from which [the invention] sprang is so poorly understood that it qualifies as a 'black art.'" [App. 14a, 29a n.6.]

"Work function" is thus a scientific matter or, at the least, a matter requiring technical knowledge or "other specialized knowledge." Rule 702. But ESAB met *none* of Rule 702's requirements: it had *no* witness who qualified as an expert on work function, let alone one who testified on the basis of "sufficient facts or data" (the inventor, for example, did not even know the source of the data for the work-function chart presented in Col. 4 of the '425 Patent (A187-88, 107)), or on the basis of "reliable principles and methods," or by applying such "facts and principles reliably to the facts of the case."

However, while rightly rejecting ESAB's "very unscientific" reasoning, the Trial Court succumbed to its own, through its misuse of the work-function tables — a clear mistake, as the Federal Circuit fully recognized. In thus running afoul of Rule 702, the Trial Court also ran afoul of this Court's teachings in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993); *General Electric Co. v. Joiner*, 522 U.S. 136 (1997);

Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999); and *Weisgram v. Marley Co.*, 528 U.S. 440 (2000).[15]

Under *Daubert*, "the trial judge *must ensure* that any and all scientific testimony or evidence admitted is not only relevant, but *reliable*." 509 U.S. at 589 (emphasis added). *Kumho Tire* applies the same standard to technical or other specialized knowledge. 526 U.S. at 148. Here, the Trial Court relied on scientific evidence — the work-function tables — that *no* expert witness said was "reliable," and the one and *only* expert witness said was *un*-reliable for ranking the work-function values in the accused electrode.

Ironically, although the Court's post-trial decision was incorrect, its trial comments reflected that it correctly apprehended ESAB's failure to meet its burden of reliable scientific proof. For example, during the final day of trial, after the close of ESAB's direct case and while addressing Centricut's motion for judgment as a matter of law, the Court made the following comments to ESAB's counsel:

> THE COURT: No, but it would have been nice to have a witness come in here and say, I'm an expert in physical science and I've tested their device and this is the device I tested and it's theirs, and I measured the work function of the silver in terms of its thermionic emissivity measured in electron volts, and guess what, it's higher. That would have been nice. . . . So, you know, we didn't try it that way, but there might have been an easier way

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15. The fact that this was a bench trial rather than a jury trial is no bar to applying the rationale of *Daubert* and its progeny. That case law applies not only to issues of *admissibility*, but also to issues of *weight* of the evidence. *Libas, Ltd. v. United States*, 193 F.3d 1361, 1366 (Fed. Cir. 1999). *Accord, Elliott v. Commodity Futures Trading Commission*, 202 F.3d 926, 934 (7th Cir. 2000). *See Mitchell v. United States*, 141 F.3d 8, 14-17 (1st Cir. 1999); and *cf. Perez-Trujillo v. Volvo Car Corporation (Sweden)*, 137 F.3d 50, 52, n.5 (1st Cir. 1998). Moreover, Rule 702 itself is couched in terms of the "trier of fact."

to try it. So here we are on this long, winding, inferential, deductive road. And what you're going to have to do is, since you don't have a little completed picture for me and all you have is these puzzle pieces, you're going to have to put those puzzle pieces together for me. [A927-28 (emphasis added).]

THE COURT: Sure. And I'm sitting here asking myself a simple question. *Does their device have that? Have what? Does it have a silver sleeve surrounding the emissive insert that has a higher work function than the emissive insert* in the copper. Does it have that? *No one has gotten on this stand and said, yes, it does because I've tested it.*

MR. ARROYO: Your Honor, I submit to you that no one has to get on the stand and say that they've tested it.

THE COURT: Okay. You're right.

MR. ARROYO: They all come in and admit that they designed it.

THE COURT: *You could get on the stand and say, we don't have to test it because by definition, silver has a higher work function than hafnium and by definition, silver has a higher work function than copper. But nobody seems to be willing to say that either.* [A931 (emphasis added).]

THE COURT: I'm sure they work. I'm sure they work, but that doesn't necessarily answer the question. Skipping ahead — I'm not going to consider this on the motion, but *Dr. [den]Boer says, I don't know.*

> *Nobody can tell you. Nobody can tell you. Silver can have a work function much lower than the hafnium. Hey, I don't know, but he's a physicist. He's the only expert that's testified on that subject, and he said silver can have a work function lower than hafnium. Once that comes into play, shouldn't there be some evidence that this particular silver doesn't*? [A933 (emphasis added).]

> THE COURT: No, there's no problem — *that's a red herring issue. There's no problem with the definition of the invention. The problem is a problem of proof.* It's not even a question of substance. *It's a question of proof. What's your proof in this courtroom to demonstrate that their device infringes*? We're in the court world now. *So this is a question of what do you have on your scale that tends to prove, more probably than not, that their silver in their accused device has a higher work function than the emissive insert in the copper and/or the copper holder? What is it? And what you seem to be saying is, well, because it works, and it wouldn't work if it didn't have a higher work function.* Because it's designed to work and it wouldn't be designed to work unless the emissive insert had a lower work function. [A934-35 (emphasis added).]

Again, the Court's trial insight into ESAB's lack of proof was correct, but impermanent. Its erroneous post-trial Order to the contrary may be examined in light of what this Court once said about inadequate scientific proof:

> [N]othing in either *Daubert* or the Federal Rules of Evidence requires a district court to admit opinion evidence which is connected to existing data only by the ipse dixit of the expert. A court may conclude that there is simply too great an analytical leap between the

> data and the opinion offered. . . . [T]he studies upon which the experts relied were not sufficient, whether individually or in combination to support their conclusions. . . .

Joiner, 522 U.S. at 146-47. Here, there is not even the "ipse dixit" of an expert to "connect[] the existing data" (the tables) to the Court's conclusion. There is *nothing* — except the Court's *own* "ipse dixit." The work-function tables "upon which the . . . [Court] relied were not sufficient, whether individually or in combination to support . . . [its] conclusions." "[T]here is simply too great an analytical leap between the data" and the Court's finding of infringement.

The Federal Circuit held that "where the accused infringer offers expert testimony negating infringement, the patentee cannot satisfy its burden of proof by relying only on testimony from those who are admittedly not expert in the field." App. 15a. That is certainly correct. Centricut would respectfully submit, moreover, that even if it had offered *no* "expert testimony negating infringement," ESAB would *still* have failed to meet its burden of proof, and the Trial Court's decision should *still* have been reversed. *Weisgram* is instructive. There, this Court unanimously held that "the authority of the Court of Appeals to direct entry of judgment as a matter of law extends to cases in which, on excision of [expert] testimony erroneously admitted, there remains insufficient evidence to support the jury's verdict." 528 U.S. at 457. For ESAB on the work function issue, there was not even erroneously admitted expert testimony; there was no expert testimony at all. Thus, even if Professor denBoer's testimony were not part of the "entire evidence" (*U.S. Gypsum Co.*, 333 U.S. at 395), the Federal Circuit's decision should stand.

III. SINCE THE FEDERAL CIRCUIT CONFINED ITS DECISION TO THE INFRINGEMENT ISSUE AND DID NOT REACH ANY ISSUES OF CLAIM CONSTRUCTION, ESAB'S ARGUMENT II IS IRRELEVANT.

In its Argument II (at 18-22), ESAB addresses claim construction, saying among other things, "It is well settled under controlling decisions that the claims of an issued patent are construed as they would be understood by persons of ordinary skill in the relevant art." The statement is correct — but irrelevant.

"The determination of infringement is a *two-step process*. First, the Court construes the claims at issue to determine their scope. Second, it compares the properly construed claims to the accused device." *Intellectual Property Development, Inc. v. UA-Columbia Cablevision of Westchester, Inc.*, 336 F.3d 1308, 1313-14 (Fed. Cir. 2003) (emphasis added). Here, the Federal Circuit's decision was confined to the second step. No issues of claim construction were addressed.[16] As the Federal Circuit said: "There was *no dispute* concerning the district court's construction of the work function limitation. The question was whether the accused device satisfied the limitation."[17] App. 7a. (emphasis added).

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16. Centricut had also appealed the Trial Court's claim construction of the "cavity" and "sleeve" limitations. But the Federal Circuit did not reach them, saying, "On appeal, Centricut urges that the district court's construction of these claim limitations was also erroneous. In view of our disposition, we do not reach these issues, and accordingly do not discuss them further." App. 6a, n. 2.

17. ESAB is thus obviously incorrect when it says (at 7) that Centricut "conceded that its accused electrode corresponded to each of the elements of the asserted claims as previously construed by the court." Although ESAB qualifies the preceding statement with the words, "with the possible exception of the so-called 'work-function limitation,'" (Cont'd)

Not only is ESAB's claim-construction argument irrelevant, but it suffers from the same infirmities of the "very unscientific" argument that was rejected by both the Trial Court and the Federal Circuit. *See* Argument IC, above.

CONCLUSION

For the foregoing reasons, ESAB's Petition for a Writ of Certiorari should be denied.

Respectfully submitted,

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(Cont'd)
the qualification is an absurd understatement. The Federal Circuit's statement, quoted above, is accurate. The question whether Centricut's accused device in fact satisfied the work-function limitation was hotly disputed. It was the foremost issue at trial; it was the foremost issue on appeal.